The world's most comprehensive encyclopedia of the military weapons of the 20th century

WAR MACHINE

An ORBIS Publication

80p **78**

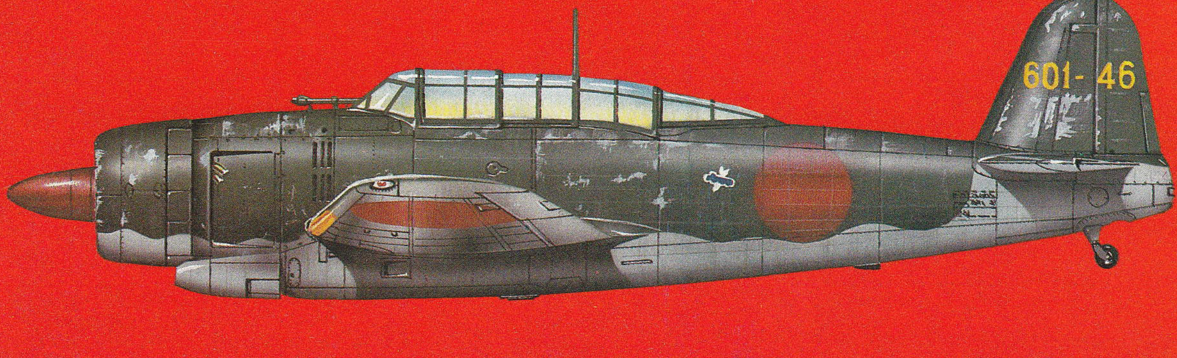
IR £1 Aus $1.95 NZ $2.25 SA R1.95 Sing $4.50 USA & Can $1.95

Douglas Dauntless in Action

Armed Forces of the World: Royal Navy (Part 1)

Attacking the Tirpitz

Carrier Air Groups



A fully illustrated guide to Carrier Aircraft of World War II

WAR MACHINE

Volume 7 **Issue 78**

Published by
Orbis Publishing Ltd
© Aerospace Publishing Ltd 1985
Colour profiles, diagrams and cutaway drawings © Pilot Press Ltd

Editorial Offices
War Machine
Aerospace Publishing Ltd
179 Dalling Road
London W6 0ES

Managing Editor: Stan Morse
Editorial: Trisha Palmer
Chris Bishop
Chris Chant
Ian Drury

Design: Rod Teasdale
Colour Origination: Imago Publishing Ltd, Thame, Oxon

Typesetting: SX Composing Ltd

Film work: Precise Litho Ltd

Artists:
Ichiro Hasegawa
Keith Woodcock

28852

Printed in Great Britain
by The Artisan Press Ltd

Subscription Manager: Christine Allen
0488 72666

Consultant Editor: Major General Sir Jeremy Moore KCB OBE MC, Commander of British Land Forces during the Falklands campaign.

Distribution and marketing offices:
Orbis Publishing Ltd
Orbis House
20-22 Bedfordbury
London WC2N 4BT
Telephone: 01-379 6711

Circulation Director: David Breed
Marketing Director: Michael Joyce

WAR MACHINE
Forthcoming issues feature:
Modern Sub Machine-Guns
Allied Destroyers of World War II
Early Missiles
Modern 1.5 to 5 Ton Trucks
Self-propelled Guns of World War II

Picture acknowledgements

Cover photograph: US Navy. **1541:** Fleet Air Arm Museum/Robert L. Lawson. **1542:** US Navy/MARS, Lincs. **1544:** Fleet Air Arm Museum/Imperial War Museum/US Navy. **1545:** US Navy/US Navy/US Navy/US Navy. **1546:** Robert L. Lawson. **1547:** Vought Corporation. **1548:** Robert L. Lawson. **1549:** Robert L. Lawson. **1552:** Robert L. Lawson. **1553:** US Navy. **1554:** US Navy/US Navy. **1555:** Fleet Air Arm Museum/Imperial War Museum. **1557:** Fleet Air Arm Museum. **1558:** RAF Museum of Aerospace/Fleet Air Arm Museum/Imperial War Museum. **1559:** Imperial War Museum/Imperial War Museum. **1560:** Imperial War Museum/Fleet Air Arm Museum. **(iii):** COI/General Electric. **(iv):** COI/Royal Navy.

HOW TO OBTAIN ISSUES AND BINDERS FOR WAR MACHINE

Issues can be obtained by placing an order with your newsagent or direct from our Subscription Department. If you have difficulty obtaining any back issues from your newsagent, please write to us stating the issue(s) required and enclosing a cheque for the cover price of the issue(s).

AUSTRALIA please write to: Gordon and Gotch (Aus) Ltd, 114 William Street, PO Box 767G, Melbourne, Victoria 3001. MALTA, NEW ZEALAND, SINGAPORE & SOUTH AFRICA: Back numbers are available at cover price from your newsagent. In case of difficulty, write to the address given for binders.

UK/EIRE
PRICE: 80p/IR£1
SUBSCRIPTION:
6 Months: £23.92
1 Year: £47.84
BINDER: Please send £3.95 per binder, or take advantage of our special offer in early issues.

EUROPE
PRICE: 80p
SUBSCRIPTION:
6 Months air: £42.12
surface: £33.54
1 Year air: £84.24
surface: £67.08
BINDER: £5.00
AIRMAIL: £5.50

MALTA
Obtain BINDERS from
your newsagent or
Miller (Malta) Ltd,
MA Vassalli Street,
Valetta, Malta
Price: £3.95

MIDDLE EAST
PRICE: 80p
SUBSCRIPTION:
6 Months air: £44.98
surface: £42.12
1 Year air: £89.96
surface: £84.24
BINDER: £5.50
AIRMAIL: £8.30

AMERICAS/ASIA/AFRICA
PRICE: US$1.95/80p
SUBSCRIPTION:
6 Months air: £53.30
surface: £42.12
1 Year air: £106.60
surface: £84.24
BINDER: £5.50
AIRMAIL: £9.50

SOUTH AFRICA
PRICE: R1.95
Obtain BINDERS from
any branch of Central
News Agency or
Intermag, PO Box
57394, Springfield
2137

SINGAPORE
PRICE: Sing$4.50
Obtain BINDERS from
MPH Distributors
601 Sims Drive
03-07-21
Singapore 1438

AUSTRALASIA/FAR EAST
PRICE: 80p
SUBSCRIPTION:
6 Months air: £57.46
surface: £42.12
1 Year air: £114.92
surface: £84.24
BINDER: £5.50
AIRMAIL: £10.00

AUSTRALIA
PRICE: AUS$1.95
Obtain BINDERS from
First Post Pty Ltd,
23 Chandos Street
St Leonards,
NSW 2065

NEW ZEALAND
PRICE: NZ$2.25
Obtain BINDERS from
your newsagent or
Gordon & Gotch (NZ)
Ltd, PO Box 1595,
Wellington

ADDRESS FOR BINDERS AND BACK ISSUES
Orbis Publishing Limited
Orbis House
20-22 Bedfordbury
London
WC2N 4BT
Telephone: 01-379-5211

Cheques/Postal Orders should be made payable to Orbis Publishing Limited. Binder prices include postage and packing and prices are in sterling.

Back Issues are sold at the cover price, and we do not charge carriage in the UK.

NOTE
Binders and back issues are obtainable subject to availability of stocks. Whilst every attempt is made to keep the price of the issues and binders constant, the publishers reserve the right to increase the stated prices at any time when circumstances dictate. Binders depicted in this publication are those produced for the UK and Australian markets only. Binders and Issues may be subject to import duty and/or local taxes, which are not included in the above prices unless stated.

ADDRESS FOR SUBSCRIPTIONS
Orbis Publishing Limited
Hurst Farm
Baydon Road
Lambourne Woodlands
Newbury
Berks
RG16 7TW
Telephone: 0488-72666

All cheques/Postal Orders should be made payable to Orbis Publishing Limited. Postage and packaging is included in subscription rates, and prices are given in Sterling.

Carrier Aircraft of World War 11

Carrierborne airpower reached such a peak in World War II that several battles in the Pacific were fought solely with carrierborne aircraft. Elsewhere the carriers were protecting convoys, fighting submarines and covering beach assaults.

Deck accidents were commonplace throughout the war, when the fevered pitch of operations forced errors in men and failures of machinery. This Seafire Mk IIC was the victim of a snapped arrester wire.

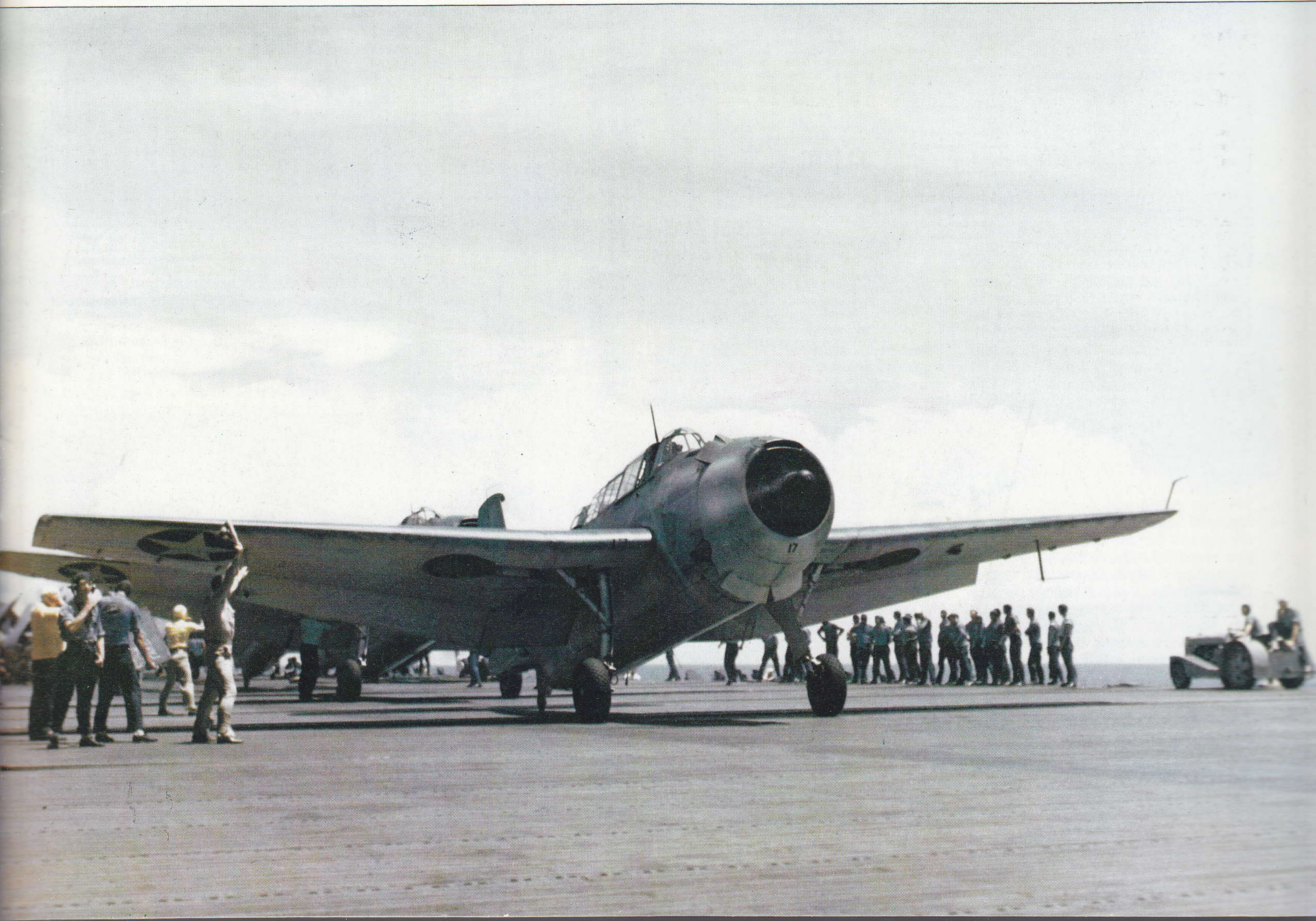
The overwhelming importance of carrierborne air power to warfare at sea was only dimly foreseen in the years prior to World War II. The battleship and naval gunnery had dominated the oceans from the days of the Spanish Armada to the Battle of Jutland, and battleships outnumbered carriers considerably in the navies of the world. Nevertheless, the 1930s saw the evolution of the methods and tactics that were to dominate the Pacific War and also contribute greatly to the successful conclusion of the war in the Atlantic. It was the US Navy who was to become the master of carrier warfare, but both the Royal Navy and the Imperial Japanese navy had made significant contributions.

The demands made by this new form of warfare were considerable, especially upon the aircraft used and upon the young men who flew them. The 'controlled crash' of a carrier landing demanded strong nerves and a strong aircraft, particularly in any sea state which could cause the deck to pitch and roll alarmingly.

In general, purpose-designed carrier aircraft had inferior performance when compared to their land-based contemporaries – although this did not prevent the Fairey Swordfish from amassing a war record second to none – and conversions of landplanes such as the Supermarine Spitfire produced performance at the expense of durability. It was left to the Japanese to show that the carrier aircraft, in the shape of the Mitsubishi A6M Zero, could outfly and outfight land-based opponents.

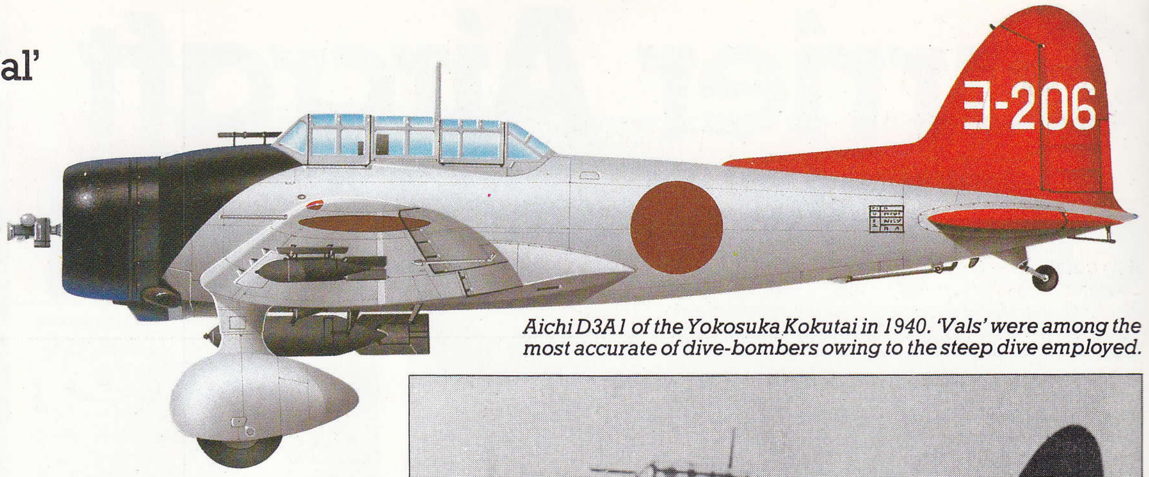
It was, however, the swarm of big, beefy US Navy aircraft based upon the massive American carrier force that was to prove decisive. Led by the Grumman F6F Hellcat and the Vought F4U Corsair, US and Allied naval aircraft in their thousands ranged the skies over Japan during the final months of the war, in a display of naval air power undreamed of only five years before.

A scene repeated many times throughout the war: Grumman TBF Avengers set off on a mission in the Pacific. This theatre brought total carrier war into the minds of the military strategists, and it was to be carrierborne air power that won the war in this vast ocean.



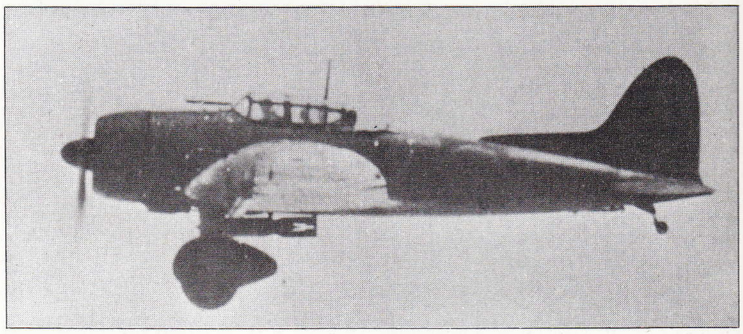
JAPAN

Aichi D3A 'Val'



Aichi D3A1 of the Yokosuka Kokutai in 1940. 'Vals' were among the most accurate of dive-bombers owing to the steep dive employed.

Although thought to be obsolescent when Japan entered the war, the **Aichi D3A** with fixed spatted landing gear was the first Japanese aircraft to drop bombs on American targets when aircraft of this type took part in the great raid on Pearl Harbor on 7 December 1941. Designed to a 1936 carrier-based dive-bomber requirement, the prototype was flown in January 1938 with a 529.4-kW (710-hp) Nakajima Hikari 1 radial. Production **D3A1** aircraft had slightly smaller wings and were powered by the 745.7-kW (1,000-hp) Mitsubishi Kinsei 43 radial. A dorsal fin extension considerably improved the aircraft's manoeuvrability, although the armament of only two forward-firing 7.7-mm (0.303-in) machine-guns, with another of the same calibre in the rear cockpit, was undeniably puny. After limited land-based operations in China and Indo-China, D3As were flown in all major carrier actions during the first 10 months of the war and sank more Allied naval vessels than any other Axis aircraft. Among British casualties in D3A1 attacks were HMS *Hermes* (the world's first carrier to be sunk by carrier aircraft), and the cruisers *Cornwall* and *Dorsetshire*. Heavy losses among D3A1s during and after the Battle of the Coral Sea, however, forced withdrawal by most of the survivors to land bases. In 1942 the **D3A2** was introduced with increased fuel capacity and more powerful engine, but by 1944 the aircraft were hopelessly outclassed by American fighters; a small number was subsequently employed in *kamikaze* attacks. Production amounted to 476 D3A1s and 1,016 D3A2. The Allied reporting name was 'Val'.



The D3A was the standard dive-bomber of the Japanese air groups during the early years of the campaign. Its most notable successes were the attacks on Pearl Harbor and the sinking of the British carrier HMS Hermes. *This is the better-looking D3A2.*

Specification
Aichi D3A2

Type: two-seat carrierborne dive-bomber

Powerplant: one 969.4-kW (1,300-hp) Mitsubishi Kinsei 54 radial piston engine

Performance: maximum speed 430 km/h (267 mph) at 6200 m (20,341 ft); climb to 3000 m (9,843 ft) in 5.76 minutes; service ceiling 10500 m (34,449 ft); range 1352 km (840 miles)

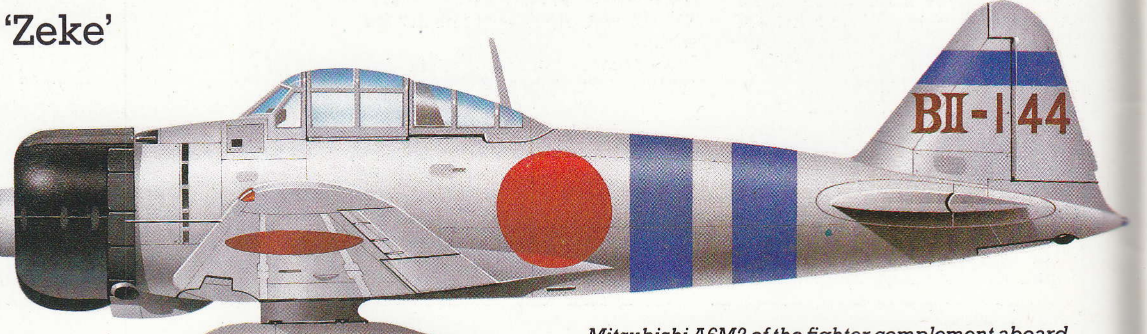
Weights: empty 2570 kg (5,666 lb); maximum take-off 3800 kg (8,378 lb)

Dimensions: span 14.38 m (47 ft 2.1 in); length 10.20 m (33 ft 5.6 in); height 3.85 m (12 ft 7.6 in); wing area 34.90 m^2 (375.7 sq ft)

Armament: two forward-firing 7.7-mm (0.303-in) Type 97 machine-guns in the nose and one trainable 7.7-mm (0.303-in) Type 92 gun in the rear cockpit, plus one 250-kg (551-lb) bomb under the fuselage and two 60-kg (132-lb) bombs under the wings

JAPAN

Mitsubishi A6M 'Zeke'



Mitsubishi A6M2 of the fighter complement aboard Hiryu during the attack on Pearl Harbor in December 1941.

The famous **Mitsubishi A6M**, popularly known as the **'Zero'**, was the first carrierborne fighter in the world capable of outperforming any contemporary land-based fighter it was likely to confront. Because of inept Allied intelligence it was able to achieve immediate air superiority over the East Indies and South East Asia from the day Japan entered the war. Designed under the leadership of Jiro Horikoshi in 1937 as a replacement for the neat but obsolescent A5M, the prototype **A6M1** was first flown on 1 April 1939 with a 581.6-kW (780-hp) Mitsubishi Zuisei 13 radial; production **A6M2** fighters with two wing-mounted 20-mm guns and two nose-mounted 7.7-mm (0.303-in) guns were fitted with the 708.4-kW (950-hp) Nakajima Sakae 12 radial, and it was with this version that the Japanese navy escorted the raiding force sent against Pearl Harbor, and gained air superiority over Malaya, the Philippines and Burma. In the spring of 1942 the **A6M3** with two-stage supercharged Sakae 21 entered service, later aircraft having their folding wing tips removed. The Battle of Midway represented the Zero's combat zenith; thereafter the agile Japanese fighter found itself ever more outclassed by the American F6F Hellcat and P-38 Lightning. To counter the new American fighters the **A6M5** was rushed to front-line units; this version, with Sakae 21 engine and improved exhaust system, possessed a top speed of 565 km/h (351 mph), more A6M5s (and subvariants) being produced than any other Japanese aircraft. It was five A6M5s of the Shikishima *kamikaze* unit that sank the carrier *St Lo* and damaged three others on 25 October 1944. Other versions were the **A6M6** with water-methanol boosted Sakae 31 engine and the **A6M7** fighter/dive-bomber. Total production of all A6Ms was 10,937. (The reporting name **'Zeke'** was given to the A6M, and **'Rufe'** to a float version, the **A6M2-N**.)

Specification
Mitsubishi A6M5b 'Zeke'

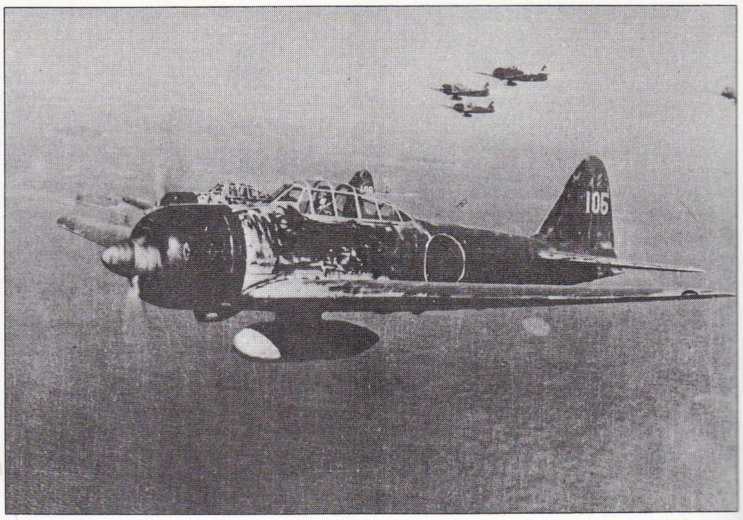
Type: single-seat carrierborne fighter

Powerplant: one 820.3-kW (1,100-hp) Nakajima NK2F Sakae 21 radial piston engine

Performance: maximum speed 565 km/h (351 mph) at 6000 m (19,685 ft); climb to 6000 m (19,685 ft) in 7.0 minutes; service ceiling 11740 m (38,517 ft); range 1143 km (710 miles)

Weights: empty 1876 kg (4,136 lb); normal loaded 2733 kg (6,025 lb)

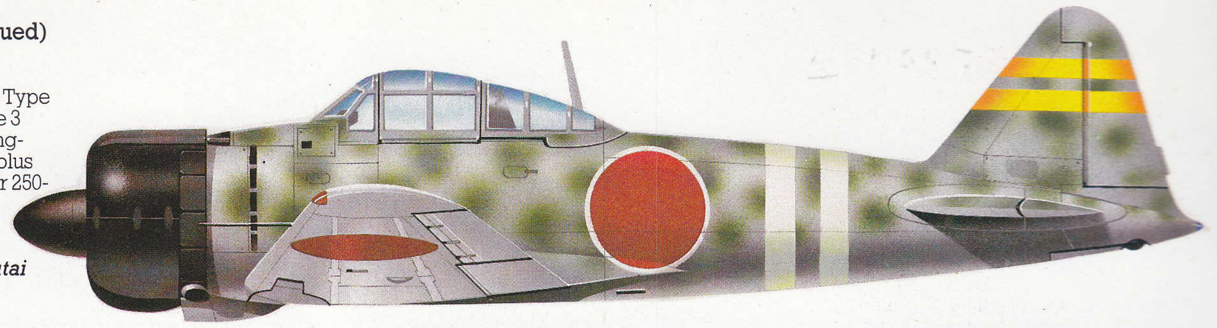
Dimensions: span 11.00 m (36 ft 1.1 in); length 9.12 m (29 ft 11.1 in); height 3.51 m (11 ft 6.2 in); wing area 21.30 m^2 (229.28 sq ft)



Feared by all Allied pilots before the arrival of the Hellcat in Pacific waters, the A6M featured astonishing manoeuvrability and good endurance, especially when equipped with an underfuselage fuel tank, as here. These A6M2s are on a long-range fighter patrol.

Mitsubishi A6M 'Zeke' (continued)

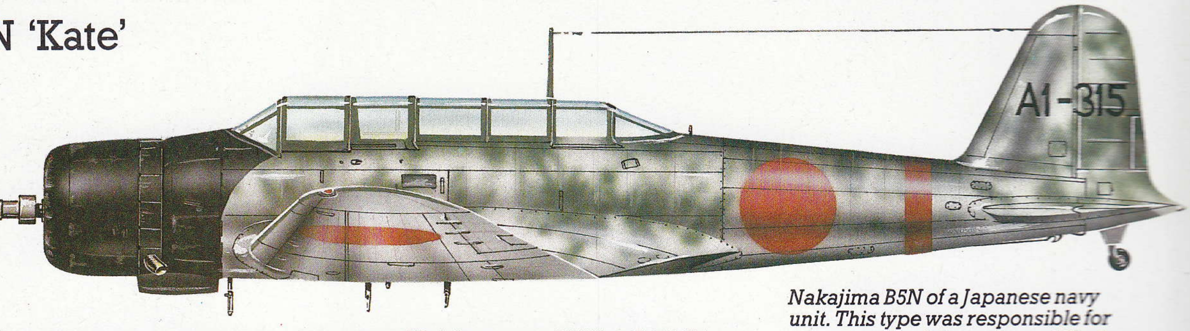
Armament: one 7.7-mm (0.303-in) Type 97 and one 13.2-mm (0.52-in) Type 3 machine-gun in nose, and two wing-mounted 20-mm type 99 cannon, plus underwing provision for two 60- or 250-kg (132- or 551-lb) bombs



Mitsubishi A6M2 of the 6th Kokutai based at Rabaul, New Britain, in November 1942.

JAPAN

Nakajima B5N 'Kate'

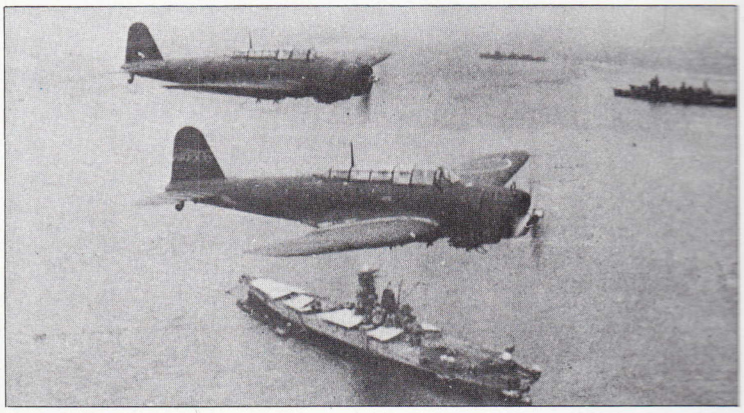


Nakajima B5N of a Japanese navy unit. This type was responsible for many successful attacks on Allied shipping in the Pacific theatre.

Designed to a 1935 requirement, and already in service for four years when Japan entered the war, the **Nakajima B5N** was in 1941 without question the best carrierborne torpedo-bomber in the world. Powered by a Nakajima Hikari radial engine, the low-wing three-crew monoplane with inwards-retracting wide-track landing gear was exceptionally clean, and first flew in January 1937. The following year production **B5N1** aircraft were embarking in Japan's carriers and shore-based units were deployed in China. In 1939 the improved **B5N2** appeared with a more powerful Sakae 11 engine in a smaller cowling, although armament and bombload were unchanged, and this version remained in production until 1943. When Japan attacked the USA the B5N2 had wholly replaced the B5N1 with operational units, and 144 B5N2s were involved in the fateful attack on Pearl Harbor; within the next 12 months aircraft of this type sank the American carriers USS *Hornet*, *Lexington* and *Yorktown*. Given the reporting name **'Kate'** by the Allies, the B5N certainly earned the respect of the Americans, and in all the major carrier battles of the Pacific War attracted the undivided attention of defending fighters. With its puny defensive armament of a single machine-gun and laden with a large bomb or torpedo, however, the B5N began to suffer very heavily, and although the type was fully committed during the Solomons campaign the survivors were withdrawn from combat after the Philippine battles of 1944. Thereafter, on account of their excellent range, they were assigned to anti-submarine and maritime reconnaissance duties in areas beyond the range of Allied fighters. Production of all B5Ns reached 1,149.

Specification
Nakajima B5N2 'Kate'

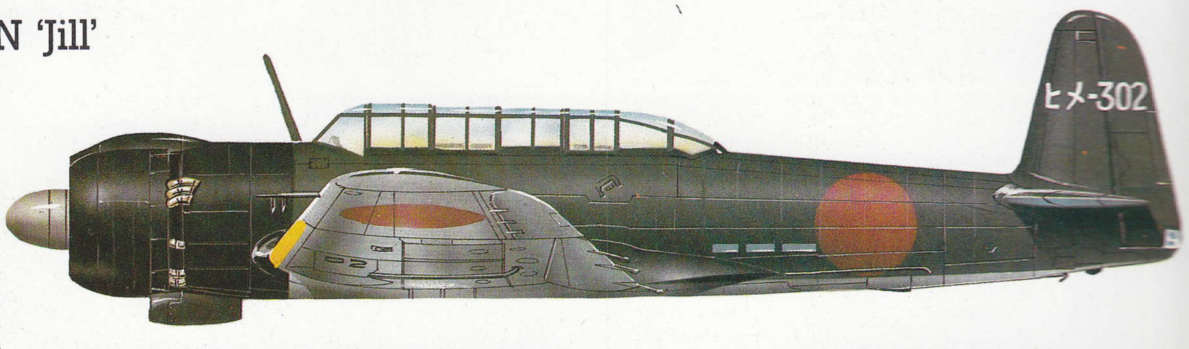
Type: three-crew carrierborne torpedo-bomber
Powerplant: one 745.7-kW (1,000hp) Nakajima NK1B Sakae 11 radial piston engine
Performance: maximum speed 378 km/h (235 mph) at 3600 m (11,811 ft); climb to 3000 m (9,843 ft) in 7.7 minutes; service ceiling 8260 m (27,100 ft); range 1990 km (1,237 miles)
Weights: empty 2279 kg (5,024 lb); maximum take-off 4100 kg (9,039 lb)
Dimensions: span 15.52 m (50 ft 11 in); length 10.30 m (33 ft 9.5 in); height 3.70 m (12 ft 1.7 in); wing area 37.70 m^2 (405.8 sq ft)
Armament: one 7.7-mm (0.303-in) Type 92 trainable machine-gun in rear cockpit, plus one 800-kg (1,764-lb) torpedo or an equivalent weight of bombs



These two B5Ns are seen flying over the mighty 70,000-ton battleship Yamato (the largest ever). The underfuselage shackles for the torpedo (or bombs) are visible.

JAPAN

Nakajima B6N 'Jill'



Nakajima B6N2 Tenzan of the Imperial Japanese Navy. This type was designed to supersede the B5N and saw intensive use during the latter part of the war.

At a time when the triumphs of the B5N were still almost three years in the future, the Japanese navy issued a specification for a replacement, recognizing that only limited overall design improvement of the B5N could be achieved in the B5N2. Accordingly design went ahead in 1939 of the **Nakajima B6N** and, despite the navy's preference for the Mitsubishsi Kasei radial, a Nakajima Mamoru was selected for the prototype which flew early in 1941. Superficially the **B6N Tenzan** (heavenly mountain) resembled the earlier aircraft, but the much increased power and torque of the big engine and four-blade propeller was found to impose considerable directional stability problems, demanding that the vertical tail surfaces be offset to one side. Flight trials dragged on, and were further delayed by troubles during carrier acceptance tests; then Nakajima was ordered to stop production of the Mamoru engine, so modifications had to be introduced to suit installation of the Kasei. In due course **B6N1** aircraft (of which only 133 were built) were embarked in the carriers *Shokaku*, *Taiho*, *Hiyo*, *Junyo* and *Zuikaku*, and took part in the great Battle of the Philippine Sea of June 1943, many being lost when the three first-named carriers were sunk. In that month production started of the slightly improved **B6N2** (of which 1,133 were produced before the end of the war), but the heavy losses among Japanese carriers resulted in the **'Jill'** being largely deployed ashore, particularly after the Battle of Leyte Gulf. Thereafter many B5Ns were consigned to the *kamikaze* role.

Specification
Nakajima B6N2 'Jill'

Type: three-crew carrierborne torpedo bomber
Powerplant: one 1379.5-kW (1,850-hp) Mitsubishi MK4T Kasei 25 radial piston engine
Performance: maximum speed 481 km/h (299 mph) at 4900 m (16,076 ft); climb to 5000 m (16,404 ft) in 10.4 minutes; service ceiling 9040 m (29,659 ft); range 1746 km (1,085 miles)
Weights: empty 3010 kg (6,636 lb); maximum take-off 5650 kg (12,456 lb)
Dimensions: span 14.89 m (48 ft 10.2 in); length 10.87 m (35 ft 8 in); height 3.80 m (12 ft 5.6 in); wing area 37.20 m^2 (400.43 sq ft)
Armament: one trainable 13-mm (0.51-in) Type 2 machine-gun in rear cockpit and one 7.7-mm (0.303-in) Type 97 machine-gun in ventral tunnel position, plus one 800-kg (1,764-lb) torpedo or an equivalent weight of bombs

Carrier Air Groups

The start of the war saw carrierborne air power well organized but still lacking experience. Throughout the conflict, the skills and technology were honed to a fine art, and ships, aircraft and tactics advanced to the stage where the carrier and its air group were in many ways the spearhead of the armed forces.

Having been equipped with Gloster Sea Gladiators and Fairey Swordfish, the Fleet Air Arm welcomed modern types such as the Fulmar and Blackburn Skua into action. However, neither type was able to hold its own against enemy aircraft.

When World War II broke out in 1939, it might be claimed that aircraft-carriers were still in their adolescence, largely because of the length of time taken to perfect equipment, an example being the fact that it was not until 15 years after the end of World War I that transverse arrester wires were finally adopted.

Of the six Royal Navy carriers in commission in 1939, only two had been designed as such from the outset (HMS *Ark Royal* and *Hermes*), the others all being conversions (HMS *Furious*, *Glorious*, *Courageous* and *Argus*). The *Argus* was promoted to front-line work only after the loss of the *Ark Royal* in November 1941.

It has to be admitted that there was a further half-dozen under construction (HMS *Illustrious*, *Formidable*, *Victorious*, *Indomitable*, *Indefatigable* and *Implacable*). But they were obviously not going to be available for some years, and the growing seriousness of the Battle of the Atlantic meant the adoption of a stop-gap measure, the use of MACships (Merchant Aircraft Carrier ships, which were merely merchant vessels fitted with small flight decks) and escort carriers (converted merchantmen with between-deck hangars and full aircraft arresting gear, with defensive guns and radar).

A residual effect of the 1922 Washington Treaty, restricting the size of carriers, had resulted in British vessels being smaller than some, but able to police a far-flung empire, so that broadly the Royal Navy tended to operate small groups or even single carriers. Their equipment was divided between obsolescent aircraft like the Fairey Swordfish and the Gloster Sea Gladiator (the former type successfully carrying out the assault on Taranto in November 1940 to which a two-carrier group was originally designated) and such modern types as the Fairey Fulmar fighter (still handicapped by the stipulated necessity to carry a navigator) and the Blackburn Skua dive-bomber. Those from the *Ark Royal*'s No. 800 Squadron were used to attack the French battleship *Richelieu* off Dakar in September 1940, about a year before the introduction of CAM-ships (Catapult Armed Merchant ships) designed to protect convoys against aerial attack using a specially modified version of the Hawker Hurricane which was designated Sea Hurricane Mk 1A. It was the first time that the Royal Navy had received an aeroplane with a performance comparable to that of land-based fighters.

The improvement in British carrier groups is amply illustrated in this picture of HMS **Colossus** ***in May 1945. On her decks are Fairey Barracudas, Supermarine Seafires and the excellent Vought Corsair.***

As the war progressed, new monoplane fighters became available, including the Vought Corsair, Grumman Wildcat, Fairey Firefly and of course the Supermarine Seafire, together with new bombers such as the Grumman Avenger and the Fairey Barracuda, so that the Royal Navy was able to make heavy raids simultaneously on the battleship *Tirpitz* in Norwegian waters and against Japanese shore installations in the East Indies.

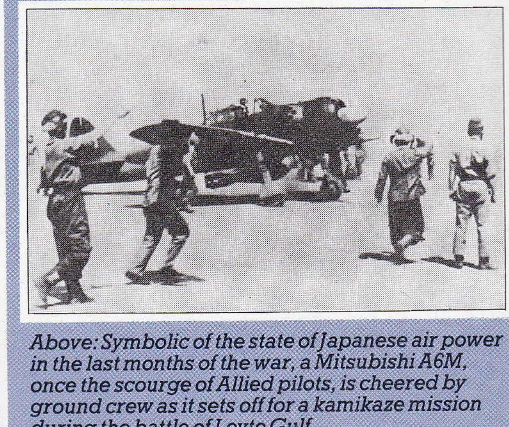
Indeed, it was in the Pacific that the Royal Navy was able to mount attacks from larger carrier groups in a relatively small area where Allied control had been secured. In this the operations were similar to those of the USA and Japan, although in all spheres advances had been made including the introduction of airborne radar, rocket armament, catapults built into the carrier decks so that whole squadron could be ranged on the rear end of the flight deck for an operation (perhaps the beginning of angle-deck thinking), or alternatively RATOG (Rocket-Assisted Take-Off Gear).

Japanese attack force

Like the Americans, the Japanese realized that operations in the wide confines of the Pacific were best carried out by large carrier groups, so that even the attack on Pearl Harbor was made from a force of six carriers (termed the 1st Air Fleet) with the 42,000-ton *Akagi* as flagship, with their aircraft numbers specially enlarged to total 430 machines. These in the main consisted of Nakajima B5N level bombers, also capable of delivering torpedoes, Aichi D3A dive-bombers and the inevitable Mistubishi A6M fighters, with a top speed of around 160 km/h (100 mph) more than that of, for example, the handicapped Fulmar. The Grumman F4Fs which had been accepted by the US Navy a year before could better the Japanese figure by some 26 km/h (16 mph). Thus rudely flung into the greater conflict, the USA had a force of seven carriers, including the 'Yorktown' class USS *Hornet*, commissioned only in the previous month, and the elderly *Langley*. This was one fewer than Japan, which boasted the strongest carrier force in the Pacific. And this force was in process of augmentation to even greater strength.

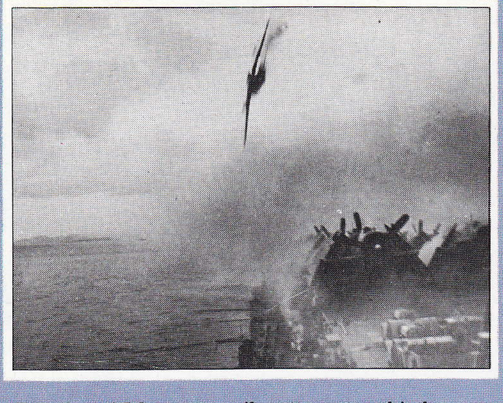
First of the war-construction Japanese carriers was the *Taiho* of 29,300 tons, at the time of delivery the most heavily protected 'flat-top' in the world with 95 mm (3.74 in) of plating on the flight deck for the 150 m (492 ft) between the lifts, which themselves had 50-mm (1.97-in) tops.

The size of the carrier groups that could be committed to Pacific operations is well illustrated by the force that was seen approaching in box formation on the opening morning of the decisive Battle of Midway. This consisted of the *Hiryu* with her 64 aircraft leading the port column with the *Soryu* (the same total of 'Zero' fighters, 'Val' dive-bombers and 'Kate' bombers) only 3600 m (3,940 yards) astern. On the other side of the defensive formation was the flagship *Akagi*, with the *Kaga* bringing up the rear. The operation was an attempt to lure the US Pacific Fleet into a trap off Hawaii, but it misfired and all members of the Japanese carrier group were crippled by Douglas SBD Dauntless dive-bombers although the USA lost the USS *Yorktown* (Task Force 17) which had been flung into the fray with the *Enterprise* and the *Hornet* making up Task Force 16. It was the division of the American force which contributed to victory, since the Japanese had believed that the *Yorktown* was the only carrier



Above: Symbolic of the state of Japanese air power in the last months of the war, a Mitsubishi A6M, once the scourge of Allied pilots, is cheered by ground crew as it sets off for a kamikaze mission during the battle of Leyte Gulf.

The second USS Yorktown *(CV-10) demonstrates its ability to land aircraft whilst sailing backwards.* Yorktown *was second of the 'Essex' class, which were to dominate the final proceedings of the Pacific war.*



Kamikaze! A Japanese pilot attempts to hit the Hellcat-laden deck of the USS Sangamon. *Such attacks became frequent from October 1944 onwards and by the last great battle at Okinawa had become the main Japanese method of attack.*

Although well-defended, aircraft carriers often suffered great damage when hit with so many aircraft in close proximity. USS Enterprise *was lucky here to escape with only a few aircraft lost after it was damaged by a bomb at Iwo Jima.*

present and that the earlier fire aboard marked her doom.

The loss of the four big carriers in this operation made it impossible for Japan to bring her powerful fleet into action, and thereafter her naval power began slowly to recede. This is not to say that there was no Japanese kick still left for the Americans to absorb, despite Japan's loss of the light carrier *Shoho*, sunk during her first and last action one month before and the first Japanese 'flat-top' to go to the bottom.

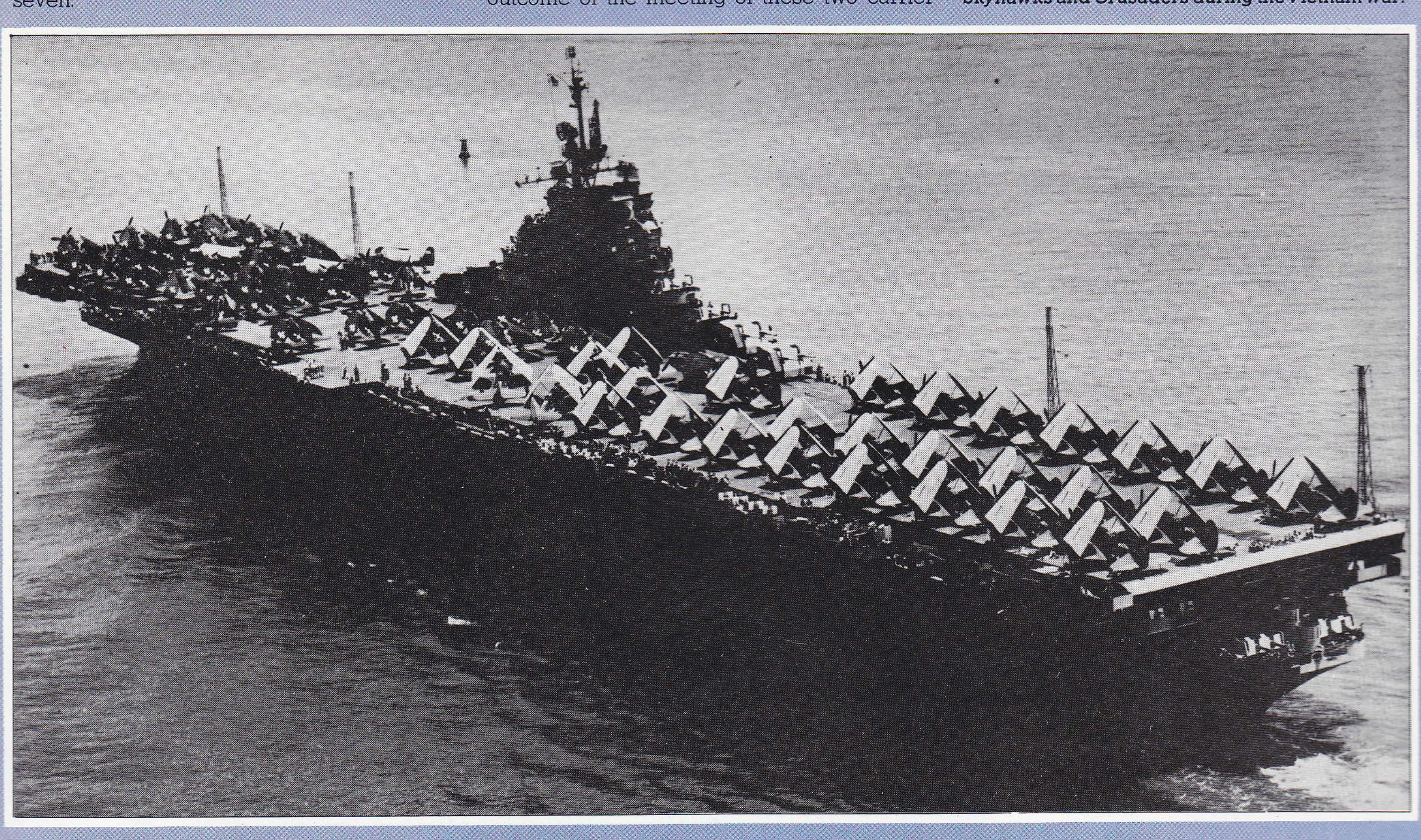
Nevertheless, the summer of 1944 found the greater part of Japan's fleet still at Tawi-Tawi under orders of Vice-Admiral Ozawa on 10 June. The force here included six aircraft-carriers shared between two divisions, and these with the rest of the force left the anchorage en route for exercises near the Philippines three days later.

Large as this muster was, it was smaller than the US fleet it encountered, the American strength comprising Task Force 58 with a massive group of eight light carriers and the fleet carriers USS *Bunker Hill*, *Wasp*, *Essex* and *Hornet*, to name only the best-known of a group of seven.

The Japanese admiral made the opening mistake of the day by launching 73 of his aircraft against the US fleet at extreme range. These were the first of 372 flown off, 242 of these being brought down from the four waves that were despatched, in this Battle of the Philippine Sea. The Americans were using in the main Grumman F6F Hellcat fighters, and it was these (together with anti-aircraft guns firing proximity-fused shells) that did the greater part of the morning's execution. US counterattacks were concentrated on the *Shokaku* and *Taiho*. Both had their aviation fuel storage ruptured so that explosive vapours spread throughout the vessels; it was obviously only a matter of time for both, and after delays (in the case of *Taiho* as long as six hours) huge internal explosions tore both apart and sank them. For Japan, the outcome of the meeting of these two carrier groups was in effect the death of her navy.

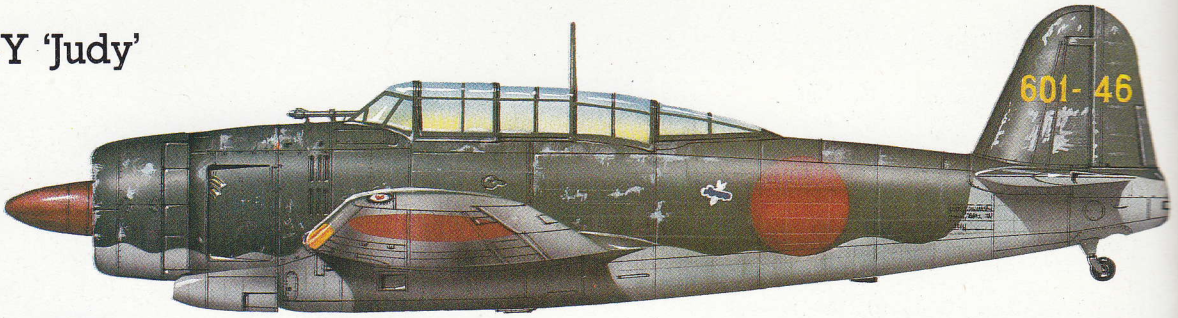
The years between the attack on Pearl Harbor and this conclusive action had been evolutionary in the use of carrier task forces for the USA. The first US carrier raids had been similar to those mounted by the Royal Navy at the time, and the first attempt to operate two carriers in a single disposition was the attack on New Guinea in March 1942. It was this first combined phase that brought the development of larger carrier task forces, which culminated in such successful operations by the groups already described.

Illustrating the overwhelming might of US naval air power in the last months, the sixth 'Essex' carrier, the USS Ticonderoga *(CV-14) sails for the Far East with Hellcats, Helldivers and Avengers on deck. In her last guise, 'Big T' would be graced with Skyhawks and Crusaders during the Vietnam war.*



JAPAN

Yokosuka D4Y 'Judy'



Well-proportioned and purposeful in appearance, the **Yokosuka D4Y** possessed an excellent performance and owed much of its concept to the German He 118, for whose manufacturing rights Japan negotiated in 1938. Designed as a fast carrier-based attack bomber and powered by an imported Daimler-Benz DB 600G engine, the **D4Y1** was first flown in December 1941; **D4Y1-C** reconnaissance aircraft were ordered into production at Aichi's Nagoya plant, the first of 660 aircraft being completed in the late spring of 1942. The first service aircraft were lost when the *Soryu* was sunk at Midway. Named **Suisei** (comet) in service and codenamed **'Judy'** by the Allies, many D4Y1s were completed as dive-bombers, and 174 Suiseis of the 1st, 2nd and 3rd Koku Sentais were embarked in nine carriers before the Battle of the Philippine Sea. However, they were intercepted by American carriers, and suffered heavy casualties without achieving any success. A new version with 1044-kW (1,400-hp) Aichi Atsuta 32 engine appeared in 1944 as the **D4Y2** but, in the interests of preserving high performance, nothing was done to introduce armour protection for crew or fuel tanks, and the sole improvement in gun armament was the inclusion of a 13.2-mm (0.52-in) trainable gun (replacing the previous 7.92-mm/0.31-in gun) in the rear cockpit. This version suffered heavily in the battle for the Philippines. Problems of reliability with the Atsuta (DB 601) engine led to adoption of a Kinsei 62 radial in the **D4Y3**, and this engine was retained in the **D4Y4** which was developed in 1945 as a single-seat suicide dive-bomber. A total of 2,033 production D4Ys was completed.

Yokosuka D4Y3 of the Imperial Japanese Navy. This version introduced the Mitsubishi MK8P Kinsei 62 radial engine, which avoided the reliability problems of the earlier Aichi Atsuta engine.

Specification

Yokosuka D4Y3 'Judy'

Type: two-seat carrierborne dive-bomber

Powerplant: one 1163.3-kW (1,560-hp) Mitsubishi MK8P Kinsei 62 radial piston engine

Performance: maximum speed 575 km/h (357 mph) at 6050 m (19,849 ft); climb to 3000 m (9,843 ft) 4.55 minutes; service ceiling 10500 m (34,449 ft); range 1520 km (944 miles)

Weights: empty 2501 kg (5,514 lb); maximum take-off 4657 kg (10,267 lb)

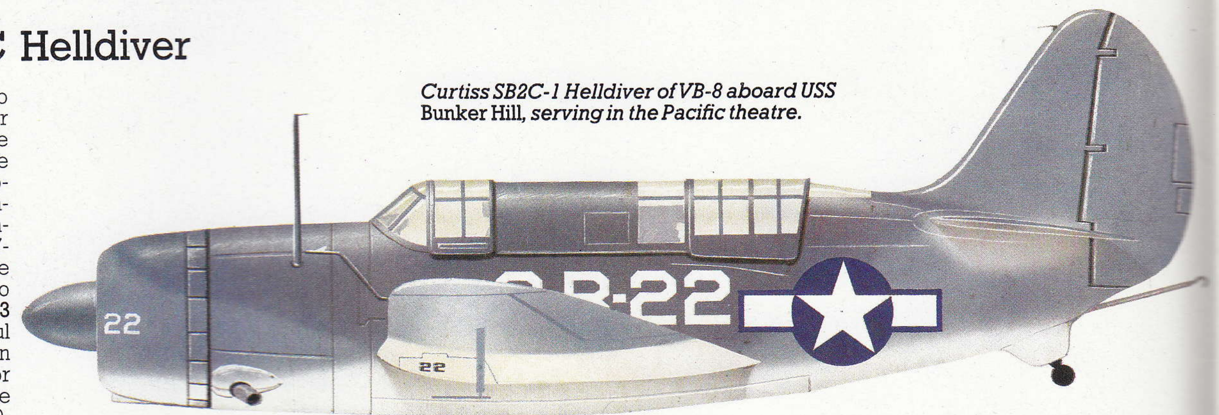
Dimensions: span 11.50 m (37 ft 8.75 in); length 10.22 m (33 ft 6.4 in); height 3.74 m (12 ft 3.2 in); wing area 23.60 m² (254.04 sq ft)

Armament: two fixed forward-firing 7.7-mm (0.303-in) Type 97 machine-guns in nose and one 13.1-mm (0.5-in) Type 2 trainable gun in rear cockpit, plus a maximum bombload of 560 kg (1,235 lb)

USA

Curtiss SB2C Helldiver

Curtiss SB2C-1 Helldiver of VB-8 aboard USS Bunker Hill*, serving in the Pacific theatre.*



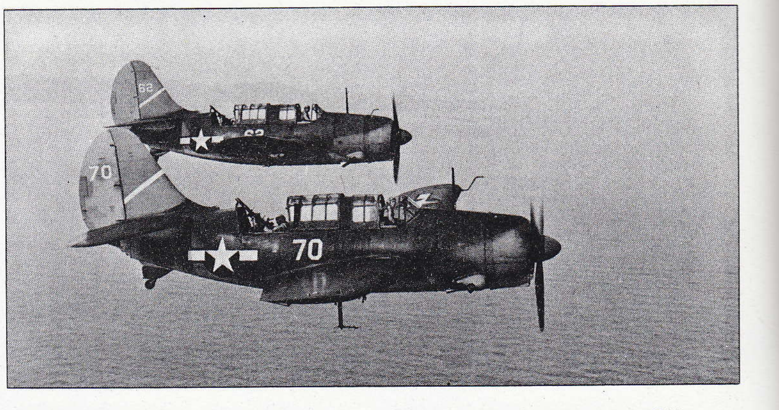
Last of a long line of Curtiss aircraft to carry the name **Helldiver** (the earlier aircraft being inter-war biplanes), the **Curtiss SB2C** was first flown as the **XSB2C-1** on 18 December 1940. Production **SB2C-1** aircraft featured an enlarged fin and rudder assembly, increased fuel capacity and four 12.7-mm (0.5-in) guns in the wings. The **SB2C-1C** carried an armament of two 20-mm guns in the wings. The **SB2C-3** appeared in 1944 with more powerful engine, and the **SB2C-4** had provision to carry eight 127-mm (5-in) rockets or 454 kg (1,000 lb) of bombs under the wings (in addition to the 454-kg/1,000-lb internal bombload); the **SB2C-4** carried radar in a small pod under the wing, and the **SB2C-5** had increased fuel. Production amounted to 7,199 of all aircraft, including 300 by Fairchild in Canada, 984 by the Canadian Car and Foundry, and 900 produced for the USAAF as the **A-25A** (most of which were taken over by the US Marine Corps and redesignated **SB2C-1A**). Helldivers first went into action on 11 November 1943 with a raid by VB-17 on Rabaul. During 1944 they gradually replaced the Douglas SBD Dauntless, and were in constant action against the Japanese. Some 26 Canadian-built aircraft were supplied to the UK.

Specification

Curtiss SB2C-4 Helldiver

Type: two-seat scout-bomber

Powerplant: one 1416.8-kW (1,900-hp) Wright R-2600-20 radial piston engine



Right: These two SB2C-1C Helldivers from VB-1 are on patrol in 1944. The Helldiver was not liked by pilots or ground crew and was referred to by many derogatory nicknames, the most common of which was 'The Beast'. Despite its reputation, the type put in much service in the thick of the battle against Japan.

Performance: maximum speed 475 km/h (295 mph) at 5090 m (16,700 ft); initial climb rate 549 m (1,800 ft) per minute; service ceiling 8870 m (29,100 ft); range 1875 km (1,165 miles)

Weights: empty 4784 kg (10,547 lb); maximum take-off 7537 kg (16,616 lb)

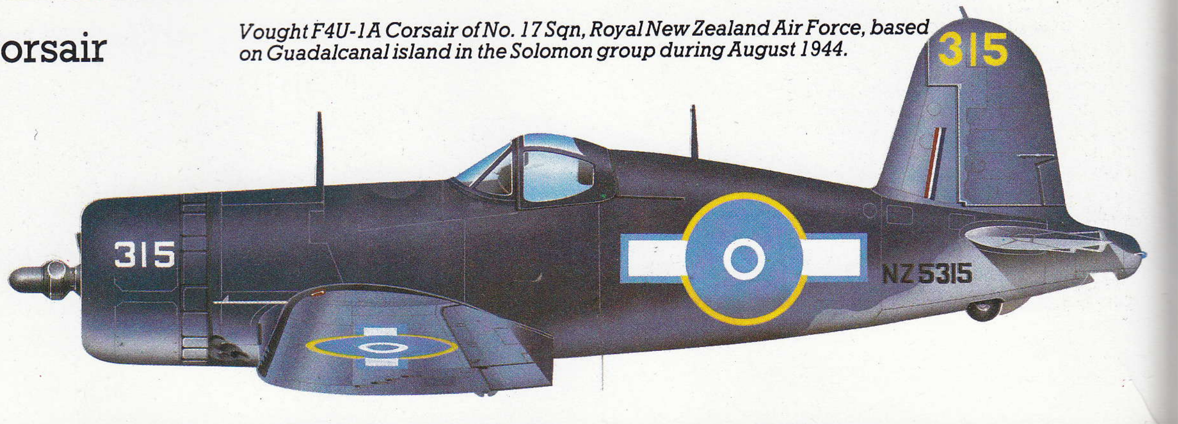
Dimensions: span 15.16 m (49 ft 9 in); length 11.18 m (36 ft 8 in); height 4.01 m (13 ft 2 in); wing area 39.20 m² (422.0 sq ft)

Armament: two fixed forward-firing 20-mm guns in the wings and two 7.62-mm (0.3-in) trainable guns in the rear cockpit, plus a bombload of 454 kg (1,000 lb) under the wings and 454 kg (1,000 lb) internally

USA

Vought F4U Corsair

Vought F4U-1A Corsair of No. 17 Sqn, Royal New Zealand Air Force, based on Guadalcanal island in the Solomon group during August 1944.

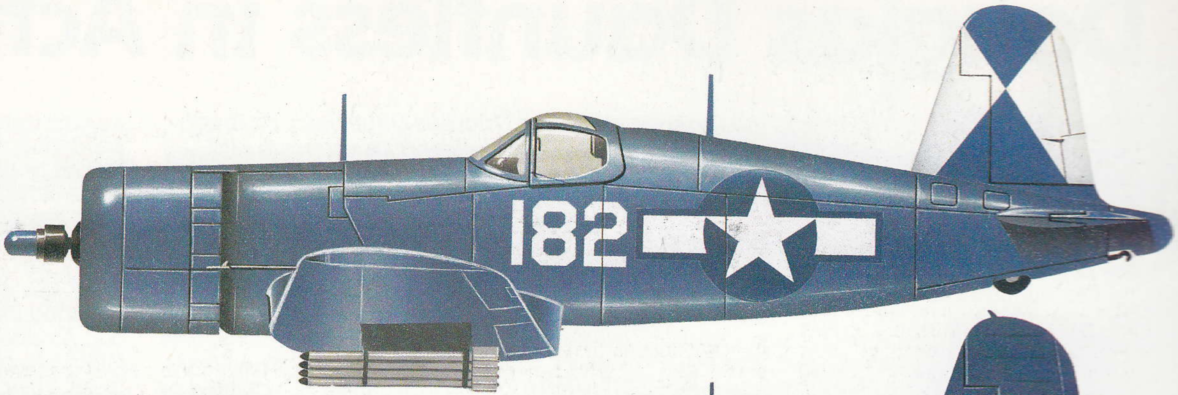


Distinctive yet not unattractive with its inverted gull wing, the **Vought F4U Corsair** was unquestionably the best shipborne fighter of the war, and gained an 11:1 kill:loss ratio in the Pacific. Designed by Rex B. Beisel, the **XF4U-1** was flown on 29 May 1940, the first production **F4U-1** fighters being delivered to VF-12 in October 1942, although most of the early aircraft went to the US Marine Corps. It was a land-

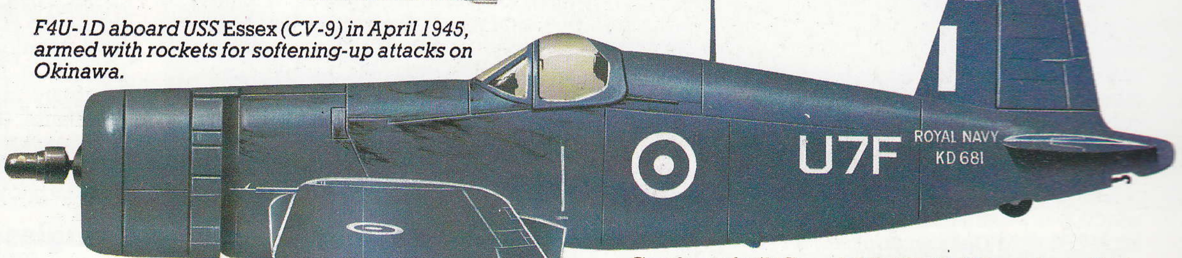
Vought F4U Corsair (continued)

based US Marine squadron, VMF-124, that first flew the Corsair into action, on 13 February 1943 over Bougainville. Additional production lines were set up by Brewster and Goodyear, these companies producing the **F3A-1** and **FG-1** respectively. To improve the pilot's field of view, later aircraft introduced a raised cockpit, and the **F4U-1C** had a four 20-mm cannon armament. The **F4U-1D, FG-1D** and **F3A-1D** were powered by water-injection boosted R-2800-8W engines, and could carry two 454-kg (1,000-lb) bombs or eight 127-mm (5-in) rockets under the wings. Late in the war a night-fighter version, the **XF4U-2**, saw limited service with VFN-75 and VFN-101. Wartime production of the Corsair (which continued until 1952 with later versions) reached 4,120 F4U-1s, 735 F3A-1s and 3,808 FG-1s; of these 2,012 were supplied to the UK's Fleet Air Arm and 370 to New Zealand. Indeed, it was the Royal Navy's **Corsair Mk II** aircraft of No. 1834 Squadron that were the first Corsairs to operate from a carrier when, on 3 April 1944, they took part in operations against the *Tirpitz*.

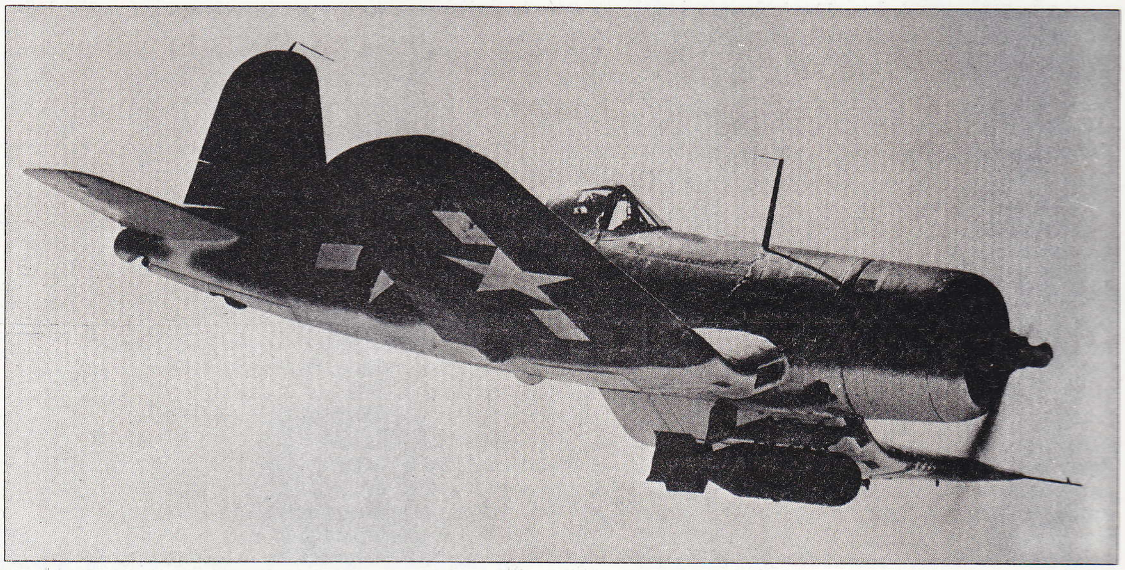
Specification
Vought F4U-1 Corsair
Type: single-seat shipboard fighter
Powerplant: one 1491.4-kW (2,000-hp) Pratt & Whitney R-2800-8 radial piston engine
Performance: maximum speed 671 km/h (417 mph) at 6066 m (19,900 ft); initial climb rate 881 m (2,890 ft) per minute; service ceiling 11247 m (36,900 ft); range 1633 km (1,015 miles)
Weights: empty 4074 kg (8,982 lb); maximum take-off 6350 kg (14,000 lb)
Dimensions: span 12.50 m (41 ft 0 in); length 10.17 m (33 ft 4.5 in); height 4.90 m (16 ft 1 in); wing area 29.17 m² (314.0 sq ft)
Armament: six forward-firing 12.7-mm (0.5-in) machine-guns in the wings



F4U-1D aboard USS* Essex *(CV-9) in April 1945, armed with rockets for softening-up attacks on Okinawa.



Goodyear-built Corsair Mk IV (FG-1D) serving with No. 1850 Sqn, Fleet Air Arm, HMS* Vengeance*, whilst on Pacific duty in 1945.



The finest naval fighter produced in the war, Vought's distinctive Corsair was also an excellent ground-attack platform with bombs and rockets.

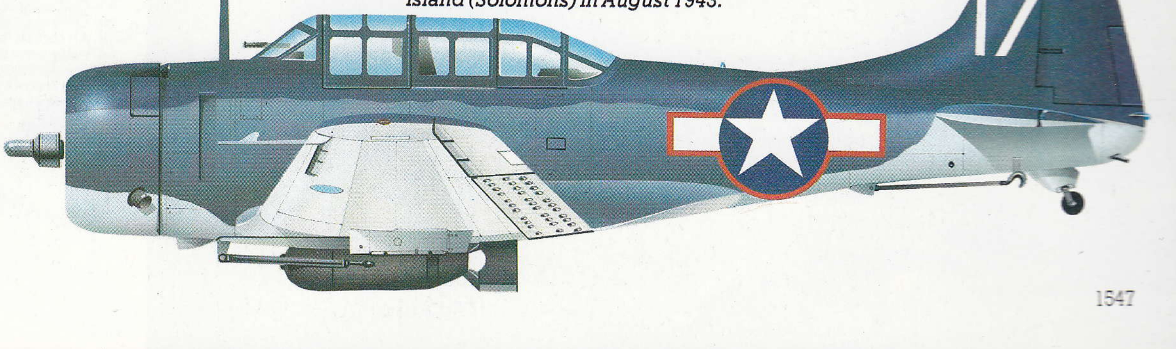
USA

Douglas SBD Dauntless

Developed directly from the **Northrop BT-1** (the Northrop Corporation became a division of Douglas), the prototype of the **Douglas SBD Dauntless** two-seat carrierborne dive bomber was in fact a much modified production BT-1. Production orders for 57 **SBD-1** and 87 **SBD-2** aircraft were placed in April 1939, the former being delivered to US Marine Corps bombing and scout-bombing squadrons, and the latter to US Navy scout and bombing squadrons. The **SBD-3**, with two additional 12.7-mm (0.5-in) guns in the nose, self-sealing tanks and R-1820-52 engine, appeared in March 1941, and by the time of Pearl Harbor in December that year 584 SBD-3s had been delivered. Some 780 **SBD-4** aircraft (with 24-volt electrical system but otherwise as the SBD-3 and produced at El Segundo, California) were built in 1942; photo-reconnaissance modifications (the **SBD-1P, SBD-2P** and **SBD-3P**) were also produced during 1941-2. A new Douglas plant at Tulsa, Oklahoma, built 2,409 **SBD-5** aircraft with 894.8-kW (1,200-hp) R-1820-60 engines, following these with 451 **SBD-6** aircraft with -66 engines. The USAAF took delivery of 168 SBD-3A, 170 SBD-4A and 615 SBD-5A aircraft as the **A-24, A-24A** and **A-24B** respectively, bringing the total Douglas production to 5,936 SBDs. They were unquestionably one of the USA's most important weapons in the Pacific war, and sank a greater tonnage of Japanese shipping than any other aircraft, as well as playing a key part in the great battles of Midway, the Coral Sea and the Solomons.

Specification
Douglas SBD-5 Dauntless
Type: two-crew carrierborne scout/dive-bomber
Powerplant: one 894.8-kW (1,200-hp) Wright R-1820-60 radial piston engine
Performance: maximum speed 394 km/h (245 mph) at 4816 m (15,800 ft); initial climb rate 363 m (1,190 ft) per minute; service ceiling 7407 m (24,300 ft); range 1770 km (1,100 miles)
Weights: empty 3028 kg (6,675 lb); maximum take-off 4924 kg (10,855 lb)
Dimensions: span 12.65 m (41 ft 6.25 in); length 10.06 m (33 ft 0 in); height 3.94 m (12 ft 11 in); wing area 30.19 m² (325.0 sq ft)
Armament: two fixed forward-firing 12.7-mm (0.5-in) machine-guns and two trainable 7.62-mm (0.3-in) guns in rear cockpit, plus a bombload of one 726-kg (1,600-lb) bomb under the fuselage and two 147-kg (325-lb) bombs under the wings

Douglas SBD-4 Dauntless of VMSB-243, 1st Marine Air Wing, USMC, based on Munda, New Georgia island (Solomons) in August 1943.



Douglas Dauntless in Action

No aircraft did more to damage the Japanese than the Douglas Dauntless. Its tough frame enabled it to absorb enormous damage whilst delivering an accurate and heavy blow. Together with its brave and highly-skilled pilots, the Dauntless sank ship after ship throughout the Pacific war.

The Douglas SBD Dauntless, or Slow But Dauntless as it was often called, started life as one of the first all-metal low wing monoplane bombers to be built to US Navy specifications. A pre-war design, it was already regarded as obsolescent by the time the United States entered World War II. Nevertheless it succeeded in accounting for most of the damage inflicted during World War II on Japanese carriers, as well as having considerable success against other types of enemy ship. In 1942, it was responsible for sinking more ships than the combined efforts of all other types of US Navy aircraft. Chief designer was Ed Heinemann.

The SBD started life as the Northrop BT-1, which was essentially that company's successful A-17A dive-bomber adapted for carrier operation. The XBT-1 first flew in July 1935, but was not initially a success, a new split-type dive-flap being a particular source of trouble, causing severe buffeting over the tailplane. Following wind-tunnel tests, however, this problem was solved by perforating the dive-flaps, but there were other problems which were thought to be due to it being underpowered with a 700-hp (522-kW) Pratt & Whitney Twin Wasp Junior R-1535-66 engine, later replaced by the 825-hp (615.2-kW) R-1535-94 version.

Development led to the XBT-2, with improved streamlining, fully retracting inward-folding wheels and a 1,000-hp (745.7-kW) Wright Cyclone R-1820-32 engine. This first flew in April 1938, but by that time the Northrop works had become the El Segundo plant of the parent Douglas company, and in consequence the aircraft was restyled the Douglas SBD-1 or Dauntless when ordered into production. An initial contract for 57 machines was placed in April 1939, but the type then failed to meet newly introduced standards for aerodynamic stability. Rigorous flight testing of numerous modifications, including 21 different tail surfaces and 12 different sets of ailerons, led to an improvement, and production recommenced, but the SBD-1 lacked adequate armoured protection for the crew, and had only a limited duration. It was consequently relegated for use by the US Marine Corps, the first to receive the type being Marine Air Group 1 at Quantico, Virginia.

US Navy squadrons received instead the first of 87 SBD-2s, fitted with a 295-litre (65-Imp gal) fuel tank in each of the outer wing panels, to give a range of around 2225 km (1,385 miles). With the ability to make lengthy flights over water, it was also necessary to fit an autopilot. They were followed on the production lines by 584 SBD-3s, of which the first 174 had originally been destined for the Aéronavale. These had the improved 1,000-hp (745.7-kW) Wright Cyclone R-1820-52 engine, armour-plating for the crew, rubber-lined aluminium-alloy self-sealing tanks and a new electrical system. Twin 7.62-mm (0.3-in) trainable guns were fitted in the rear cockpit of later machines. A further 168 machines of this type were produced at the Tulsa plant for the US Army under the designation A-24.

Continued development led to the production of 780 SBD-4s, with various improvements including an electric fuel pump plus an electric emergency fuel pump, a 24-volt electrical system, Westinghouse ASB radar, radio direction finder (DF) gear for overwater navigation, and a constant-speed propeller; 170 more were provided to the US Army as the A-24A, being mostly used for training purposes. Continued development led to the SBD-5, the main production version, of which 3,639 were built, including 615 as the A-24B. This was virtually identical to the SBD-4, fitted instead with the 1,200-hp (894.8-kW) Wright Cyclone R-1820-66 engine, but the extra power was quite inadequate to compensate for the weight of all the extra equipment now being fitted. Nevertheless it saw considerable combat, replacing the earlier versions during 1943.

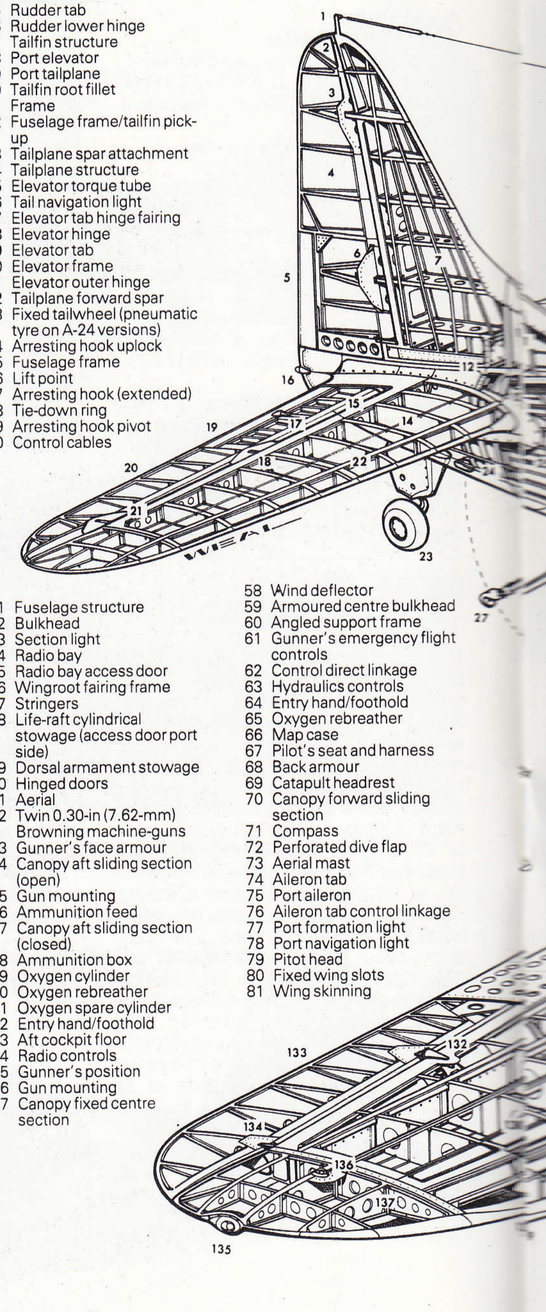
Finally came the SBD-6, of which 451 were built with automatic mixture-control, improved laminated-rubber self-sealing fuel tanks, and external underwing drop tanks. In this latter version it could achieve a range of 1930 km (1,200 miles) whilst carrying a 454-kg (1,000-lb) load of bombs, or 2735 km (1,700 miles) when operating as a scout. Nevertheless its 1,350-hp (1006.7-kW) Wright Cyclone R-1820-66 engine was still unsufficient, and by 1944 the Dauntless was being replaced in carrier service by the Curtiss Helldiver. Nine SBD-5s were supplied to the Royal Navy as the Dauntless Mk I, but were used only for trials. The Royal New Zealand Air Force took over a total of some 68 SBD-3, SBD-4 and SBD-5 aircraft, and some of these saw action in the Solomon Islands.

During the first few weeks after Pearl Harbor, American carriers made isolated raids on Japanese positions, and SBDs were involved in these. Their first really effective use, however, was in the Battle of the Coral Sea on 7 May 1942. This developed when the US Navy moved to prevent a Japanese attempt to occupy Port Moresby in New Guinea. Living up to their nickname, 45 SBDs from the USS *Yorktown* and USS *Lexington* sank the small Japanese carrier *Shoho*, which had commissioned only four months earlier, and followed this up the follow-

Early Dauntlesses are prepared for a mission. Whilst the Dauntless equipped most of the bombing squadrons early in the war, their stablemate, the TBD Devastator (aft with folded wings), equipped the torpedo squadrons.

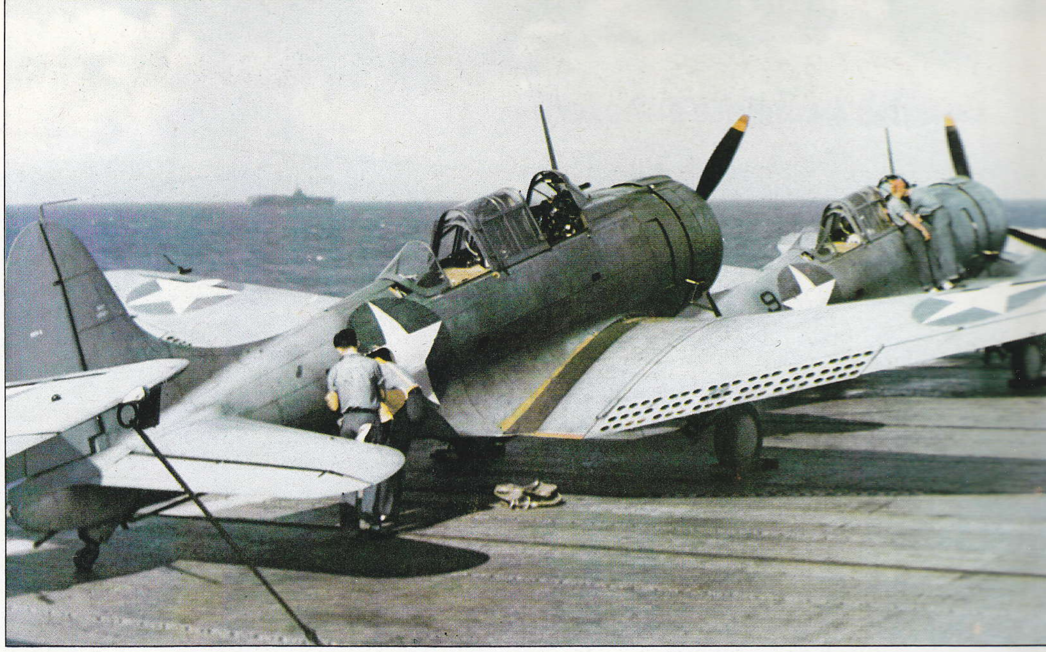
Douglas SBD-3 Dauntless cutaway drawing key

1 Aerial stub
2 Rudder balance
3 Rudder upper hinge
4 Rudder frame
5 Rudder tab
6 Rudder lower hinge
7 Tailfin structure
8 Port elevator
9 Port tailplane
10 Tailfin root fillet
11 Frame
12 Fuselage frame/tailfin pick-up
13 Tailplane spar attachment
14 Tailplane structure
15 Elevator torque tube
16 Tail navigation light
17 Elevator tab hinge fairing
18 Elevator hinge
19 Elevator tab
20 Elevator frame
21 Elevator outer hinge
22 Tailplane forward spar
23 Fixed tailwheel (pneumatic tyre on A-24 versions)
24 Arresting hook uplock
25 Fuselage frame
26 Lift point
27 Arresting hook (extended)
28 Tie-down ring
29 Arresting hook pivot
30 Control cables
31 Fuselage structure
32 Bulkhead
33 Section light
34 Radio bay
35 Radio bay access door
36 Wingroot fairing frame
37 Stringers
38 Life-raft cylindrical stowage (access door port side)
39 Dorsal armament stowage
40 Hinged doors
41 Aerial
42 Twin 0.30-in (7.62-mm) Browning machine-guns
43 Gunner's face armour
44 Canopy aft sliding section (open)
45 Gun mounting
46 Ammunition feed
47 Canopy aft sliding section (closed)
48 Ammunition box
49 Oxygen cylinder
50 Oxygen rebreather
51 Oxygen spare cylinder
52 Entry hand/foothold
53 Aft cockpit floor
54 Radio controls
55 Gunner's position
56 Gun mounting
57 Canopy fixed centre section
58 Wind deflector
59 Armoured centre bulkhead
60 Angled support frame
61 Gunner's emergency flight controls
62 Control direct linkage
63 Hydraulics controls
64 Entry hand/foothold
65 Oxygen rebreather
66 Map case
67 Pilot's seat and harness
68 Back armour
69 Catapult headrest
70 Canopy forward sliding section
71 Compass
72 Perforated dive flap
73 Aerial mast
74 Aileron tab
75 Port aileron
76 Aileron tab control linkage
77 Port formation light
78 Port navigation light
79 Pitot head
80 Fixed wing slots
81 Wing skinning



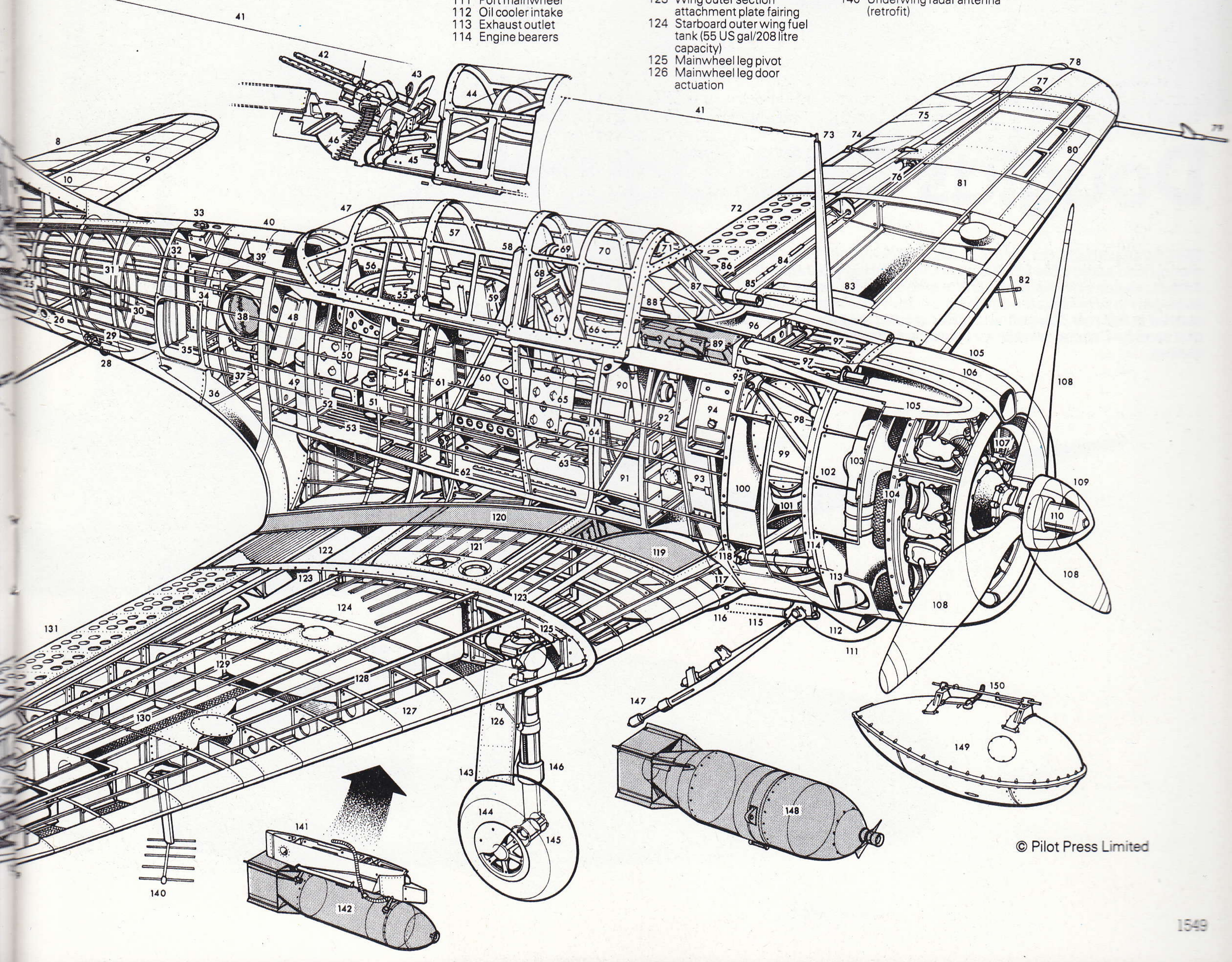
ing day with an attack by 46 machines which achieved three hits on the carrier *Shokaku*, which was lucky to survive. Unfortunately the *Lexington* was herself lost that day.

A month later, the Battle of Midway on 4 June 1942 marked a turning point in the run of Japanese successes in the Pacific. Under the mistaken impression that both the *Lexington* and the *Yorktown* had been sunk in the Coral Sea, the Japanese decided to try to capture Midway Island in the central Pacific and so bring the US Pacific Fleet's forces to decisive battle. Thanks to good intelligence, the *Yorktown* was able to make for the area, supported by the USS *Enterprise* and USS *Hornet*. Early in the battle, 16 US Marine Corps SBDs were sent

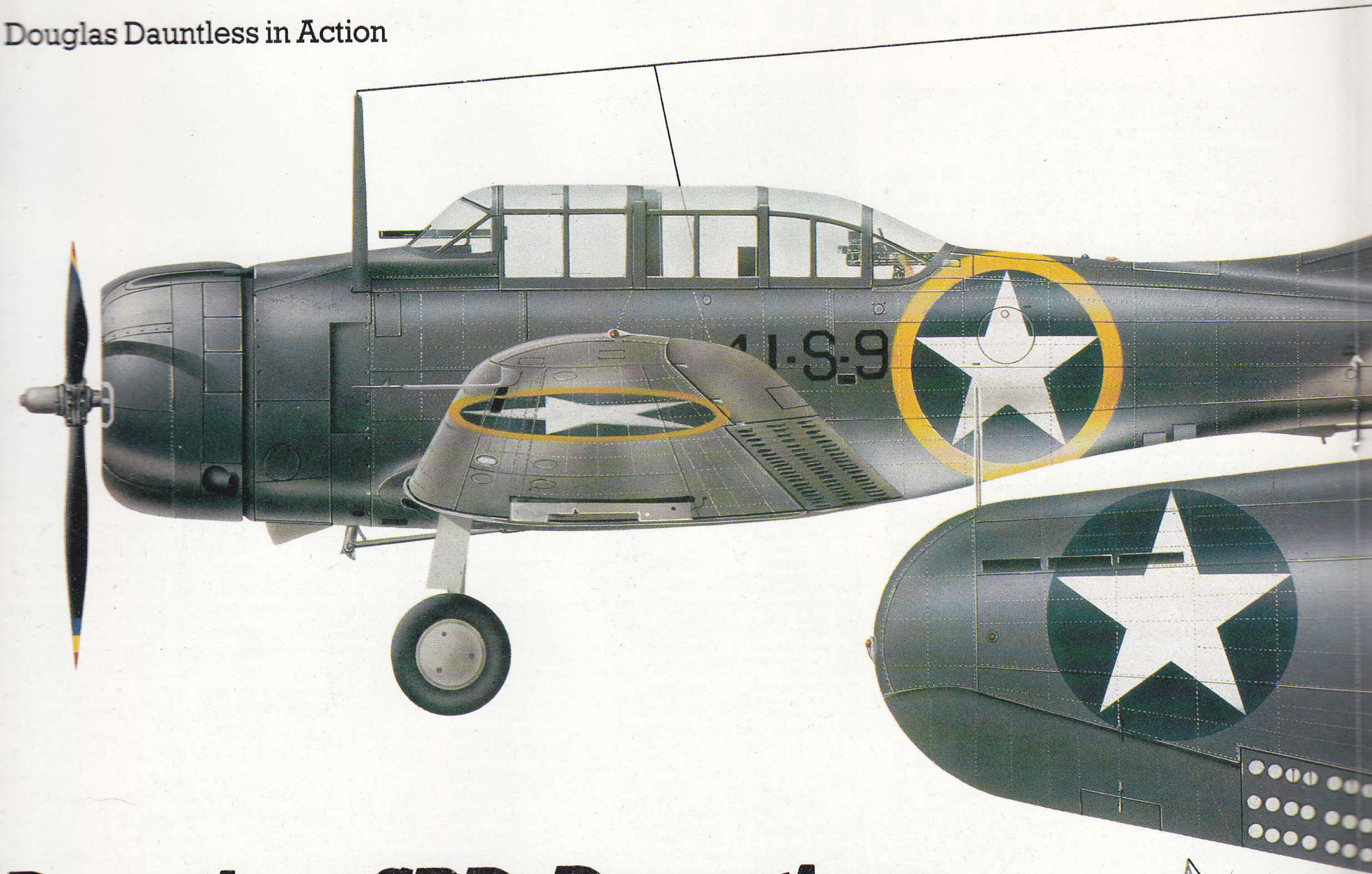


This Dauntless is undergoing radio maintenance through a hatch in the fuselage. The aircraft's sieve-like flap/divebrake is clearly visible.

82 Underwing ASB radar antenna (retrofit)
83 Port outer wing fuel tank (55 US gal/208 litre capacity)
84 Aileron control rod
85 Telescopic sight
86 Windscreen
87 Armoured inner panel
88 Instrument panel shroud
89 Two 0.50-in (12.7-mm) machine-guns
90 Control column
91 Switch panel
92 Instrument panel
93 Case ejection chute
94 Ammunition box
95 Engine bearer upper attachment
96 Armoured deflection plate
97 Machine-gun barrel shrouds
98 Engine bearers
99 Oil tank
100 Exhaust slot
101 Oil cooler
102 Cooling gills
103 Exhaust manifold
104 Engine cowling ring
105 Machine-gun troughs
106 Carburettor air intake duct
107 Wright R-1820-52 Cyclone radial engine
108 Three-blade propeller
109 Spinner
110 Propeller hub
111 Port mainwheel
112 Oil cooler intake
113 Exhaust outlet
114 Engine bearers
115 Bomb displacement crutch (in-flight position)
116 Hydraulics vent
117 Case ejection chute outlet
118 Engine bearer lower attachment
119 Starboard mainwheel well
120 Wingroot walkway
121 Starboard/inner wing fuel tank (75 US gal/284 litre capacity)
122 Centre-section dive flap (lower)
123 Wing outer section attachment plate fairing
124 Starboard outer wing fuel tank (55 US gal/208 litre capacity)
125 Mainwheel leg pivot
126 Mainwheel leg door actuation
127 Wing nose ribs
128 Multi-spar wing structure
129 Wing ribs
130 Stiffeners
131 Perforated dive flaps
132 Aileron inner hinge
133 Starboard aileron frame
134 Aileron outer hinge
135 Starboard navigation light
136 Starboard formation light
137 Wingtip structure
138 Fixed wing slots
139 Wing leading-edge
140 Underwing radar antenna (retrofit)
141 Underwing stores pylon
142 100-lb (45.4-kg) bomb
143 Mainwheel leg door
144 Starboard mainwheel
145 Mainwheel axle
146 Mainwheel leg
147 Bomb displacement crutch
148 500-lb (226.8-kg) bomb
149 Aluminium drop tank (58 US gal/219.5 litre capacity)
150 Underwing shackles/fuel line

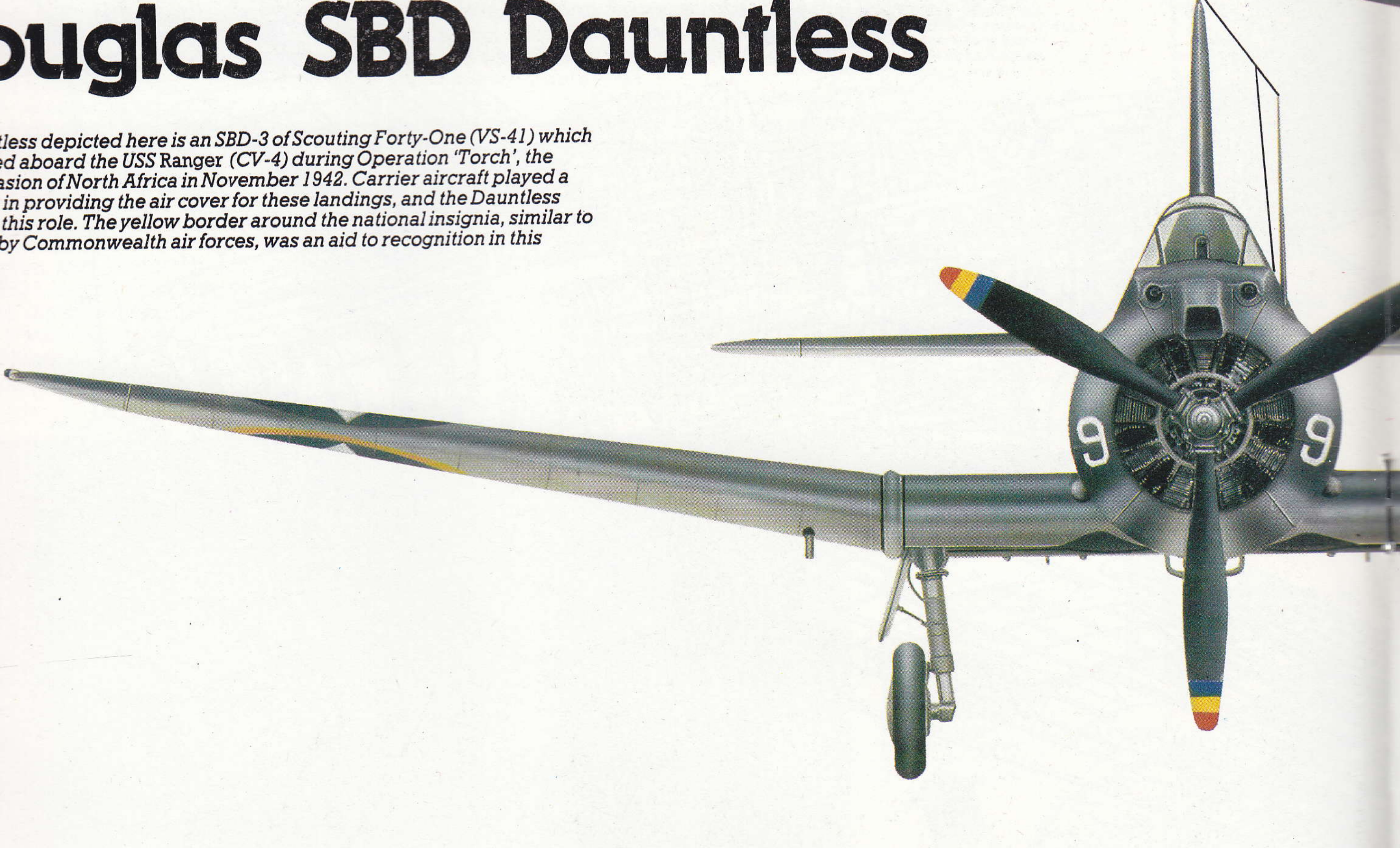

41
42
43
44
8
9
10
45
46
41
73
74
78
77
75
79
80
81
76
33
40
47
72
57
58
69
70
71
86
84
83
82
32
39
56
55
68
59
87
85
31
34
30
38
48
67
66
88
96
97
89
26
29
28
35
37
36
50
49
52
51
53
54
61
60
65
64
63
62
90
91
92
93
94
95
98
99
100
101
102
103
104
105
106
107
108
109
110
120
121
122
119
118
117
116
115
114
113
112
111
123
124
125
131
129
128
127
130
126
143
146
144
145
147
148
149
150
141
142
140

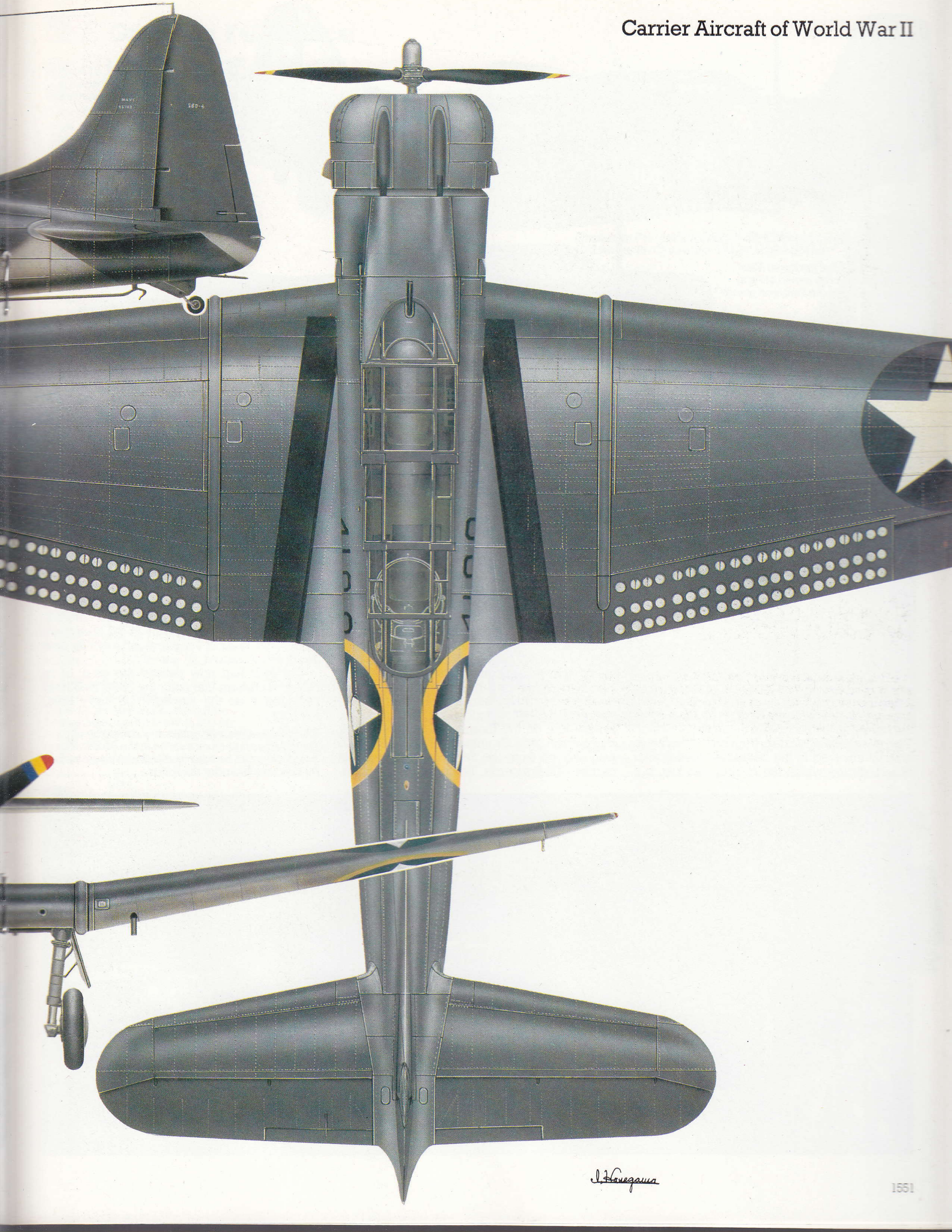
© Pilot Press Limited

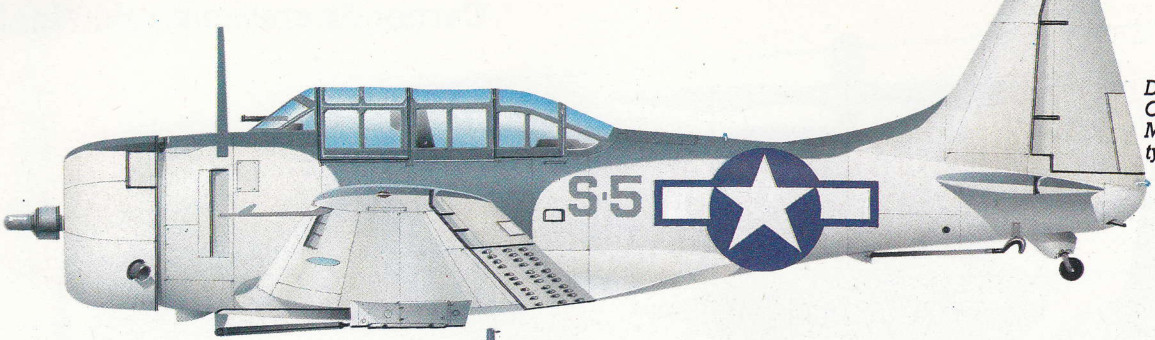


Douglas SBD Dauntless

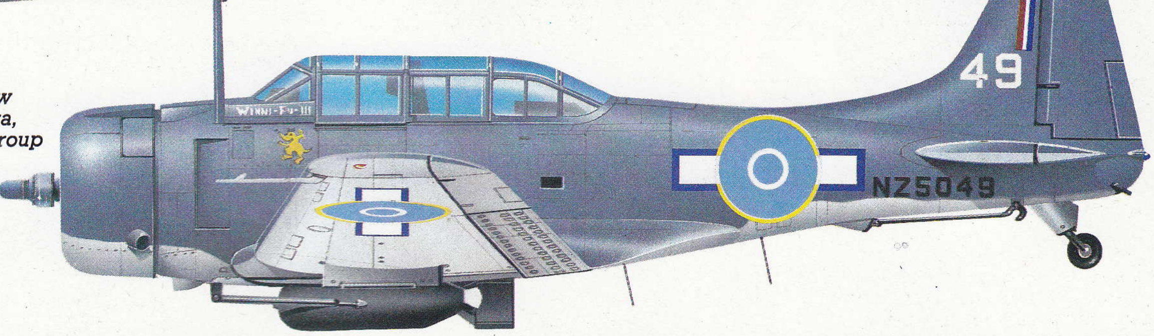
The Dauntless depicted here is an SBD-3 of Scouting Forty-One (VS-41) which was carried aboard the USS Ranger *(CV-4) during Operation 'Torch', the Allied invasion of North Africa in November 1942. Carrier aircraft played a large part in providing the air cover for these landings, and the Dauntless starred in this role. The yellow border around the national insignia, similar to that used by Commonwealth air forces, was an aid to recognition in this theatre.*




NAVY
SBD-4
I. Hasegawa



Douglas SBD-5 of VMS-3, US Marine Corps, based in the Caribbean in May 1944. This aircraft displays the typical Atlantic paint scheme.



Douglas SBD-5 of the Royal New Zealand Air Force based at Piva, Bougainville, in the Solomon group during April 1944.

out from Midway Island, but Japanese fighters shot down half of them and drove back the others. Still unaware of the proximity of the American naval force, the Japanese carriers concentrated on preparing for a second strike on Midway. They decimated an attacking force of Douglas TBD Devastators but this left them without fighter protection when 50 SBDs turned up. In a dive-bombing attack which lasted only one minute, the SBDs destroyed the main elements of the Japanese carrier force, leaving behind the burning remains of the *Soryu*, *Akagi* and *Kaga*, the *Hiryu* being scuttled later as a result of damage. The Japanese withdrew on the following day, abandoning their planned invasion.

The emphasis in the Pacific then moved south to the Solomon Islands, which the Japanese had already occupied and on which they were now busy constructing airfields. In the Battle of the Eastern Solomons, on 24 August, SBDs from the USS *Saratoga* sank the carrier *Ryujo* and scored a hit on the *Shokaku*. Two months later carriers from both sides were heavily involved in the battle for Guadalcanal Island, during which the *Hornet* was lost, but not before her SBDs had inflicted further damage on the *Shokaku*.

Whilst the US Navy's prime concern was the Pacific theatre, it was not entirely absent from activities farther west. During Operation 'Torch', the North African landings in November 1942, SBDs operated from both the USS *Ranger* and USS *Sangamon*. Then in the autumn of 1943 the *Ranger* was lent to the Royal Navy's Home Fleet when HMS *Illustrious* was redeployed to the Mediterranean, and on 4 October its air group, which included 27 SBDs, made a surprise attack on German ships at anchor in Bodo harbour, sinking five and damaging a further five.

Meanwhile the Japanese were being gradually pushed back in the Solomons, but progress was slow, resulting mainly from a shortage of carriers. At the beginning of November 1943, however, American troops went ashore in Bougainville. News then arrived that a fleet of enemy ships was assembling at Rabaul in New Britain, and on the morning of 5 November a strike force of 23 Grumman TBFs and 22 SBDs was sent off from the *Saratoga* and the light carrier USS *Princeton*. The poor weather conditions enabled the aircraft to achieve complete surprise, and they succeeded in inflicting severe damage on four heavy cruisers, as well as hitting two light cruisers and a destroyer, only one of the SBDs being lost.

By this time the Americans had begun to build many new carriers, and on 11 November three of these, the USS *Bunker Hill*, USS *Essex* and USS *Independence* joined in a second attack on Rabaul. SBDs from the *Essex* combined with new Curtiss SB2Cs from the *Bunker Hill* to make a direct hit on a destroyer, causing an explosion that jarred the attacking aircraft as they departed. The escorting fighters inflicted such heavy losses on their Japanese counterparts that the enemy carriers in the area were withdrawn to Truk for six months whilst new pilots were trained.

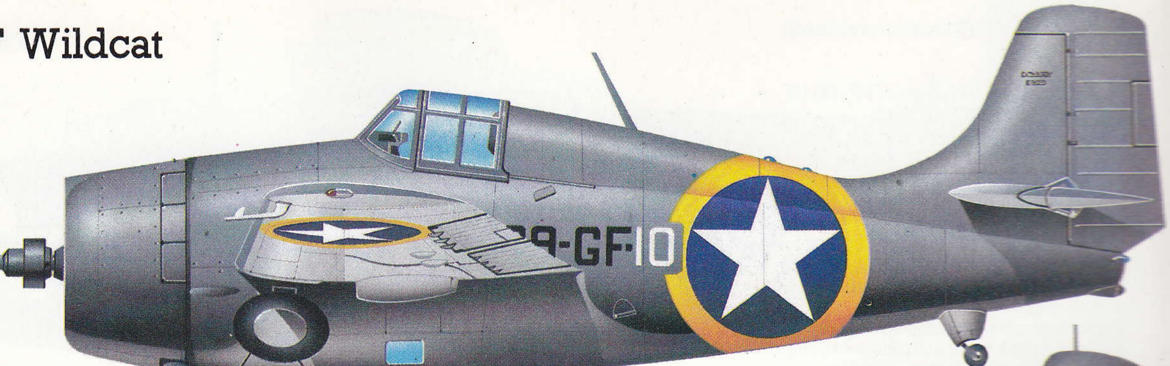
The SBD had now passed the peak of its career, and from that point the SB2C Helldiver replaced it as the standard US Navy dive-bomber.

The deck is alive with action as a squadron of Dauntlesses launch on a sortie in the Pacific. The bomb sling can be seen under the fuselage and further bombs under the wings.

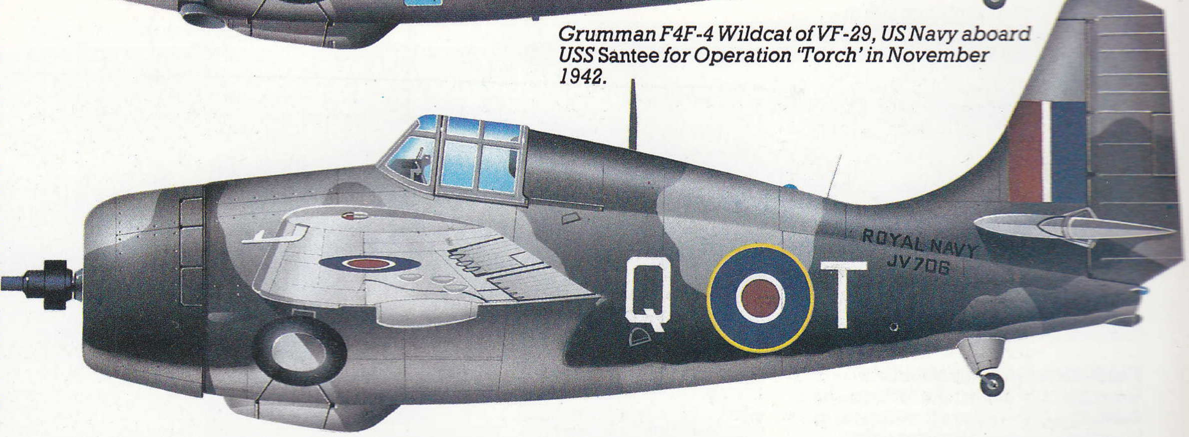
USA

Grumman F4F Wildcat

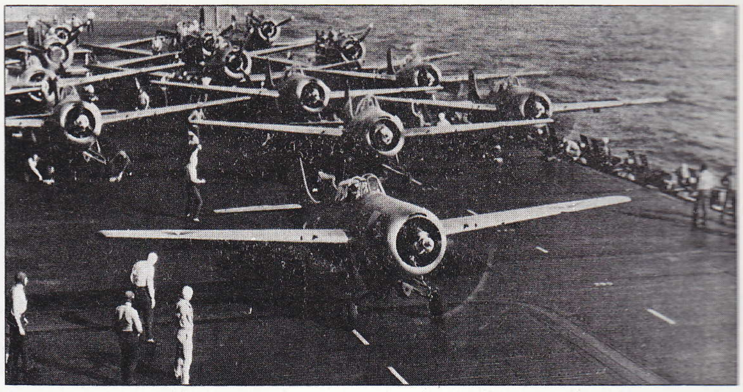
When first flown on 2 September 1937, the **Grumman XF4F-2** single-seat naval fighter prototype proved to be only 16 km/h (10 mph) faster than the Brewster F2A-1, and only when a two-stage supercharged XR-1830-76 was fitted was the true potential of the design recognized, and a speed of 537 km/h (333.5 mph) was recorded during US Navy trials with the **XF4F-3**. Some 54 production **F4F-3** fighters were ordered in August 1939, 22 of which had been delivered by the end of 1940. These aircraft (Grumman's first monoplanes for the US Navy and later named **Wildcat**) served with VF-4 and VF-7, and were followed by 95 **F4F-3A** aircraft with single-stage supercharged R-1830-90 engines. The Wildcat was ordered by France in 1939 but the entire batch of 81 aircraft was transferred to the UK, with whose Royal Navy they served as the **Martlet**, being first flown in combat during 1940. US Navy and US Marine Corps F4Fs were heavily engaged during the early months of the war with the Japanese, numerous aircraft being destroyed on the ground, but also scoring a number of outstanding victories. The **F4F-4**, with manually-folding wings (of which 1,169 were produced), was delivered during 1942, and an unarmed long-range reconnaissance version of this, the **F4F-7**, had a range of over 5633 km (3,500 miles). The F4F-4 was also built by General Motors as the **FM-1**, and a more powerful version, the **FM-2**, for operation from escort carriers. FM-1s and 2s were supplied to the UK as the **Wildcat Mk V** and **Wildcat Mk VI** (the name Martlet having been dropped). F4F-4s were heavily committed in the battles of the Coral Sea and Midway. Total production of the Wildcat (excluding prototypes) was 7,885, including 5,237 FM-1s and FM-2s by General Motors, and 1,100 for the UK.



Grumman F4F-4 Wildcat of VF-29, US Navy aboard USS Santee *for Operation 'Torch' in November 1942.*



General Motors (Grumman) Wildcat Mk VI (FM-2) of No. 835 Sqn, Fleet Air Arm, aboard HMS Nairana *in August 1944.*



Although slow and unmanoeuvrable when compared with the Mitsubishi A6M, the Grumman F4F was the best that the US Navy could field in the early days of the war. Flown by highly trained and brave pilots, the Wildcat held its own until more modern aircraft arrived in service.

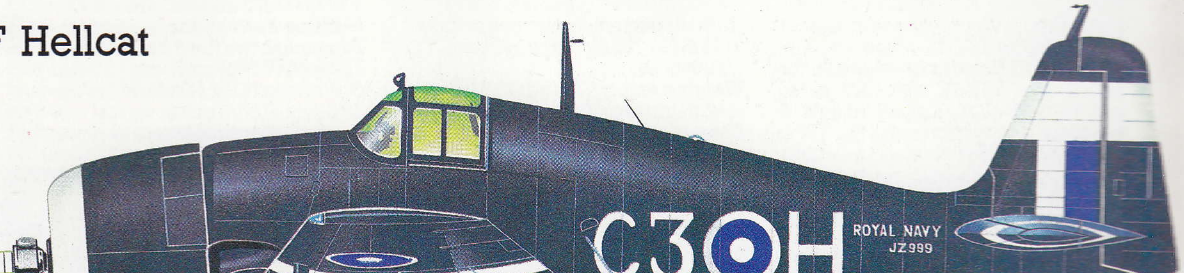
Specification
Grumman F4F-4 Wildcat
Type: single-seat shipboard fighter
Powerplant: one 894.8-kW (1,200-hp) Pratt & Whitney R-1830-86 radial piston engine
Performance: maximum speed 512 km/h (318 mph) at 5913 m (19,400 ft); initial climb rate 594 m (1,950 ft) per minute; service ceiling 10638 m (34,900 ft); range 1239 km (770 miles)
Weights: empty 2624 kg (5,785 lb); maximum take-off 3607 kg (7,952 lb)
Dimensions: span 11.58 m (38 ft 0 in); length 8.76 m (28 ft 9 in); height 3.61 m (11 ft 10 in); wing area 24.15 m^2 (260.0 sq ft)
Armament: six forward-firing 12.7-mm (0.5-in) machine guns; FM-2 had four guns and provision to carry two 113-kg (250-lb) bombs or six 127-mm (5-in) rockets

---

USA

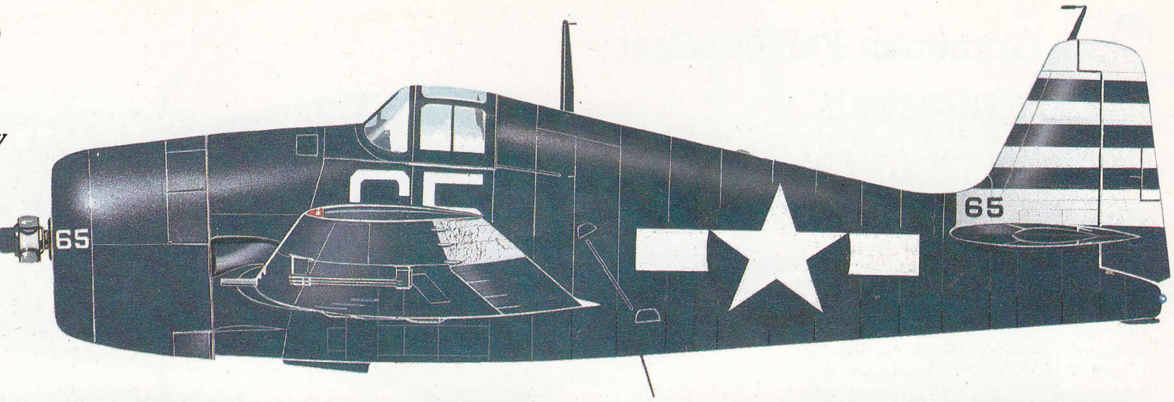
Grumman F6F Hellcat

One of America's best wartime shipboard fighters, and ably partnering the F4U Corsair, the **Grumman F6F Hellcat** was the logical development of the F4F Wildcat, and was first flown as the **XF6F-3** on 26 June 1942; this was given an uprated engine and flew again five weeks later. Deliveries to VF-9 aboard USS *Essex* started early in 1943; night-fighter versions were the **F6F-3E** and **F6F-3N** with radar in a wing pod. In 1944 the **F6F-5** appeared with provision for 907 kg (2,000 lb) of bombs and two 20-mm cannon sometimes replacing the inboard wing 12.7-mm (0.5-in) guns: the radar-equipped night-fighter version was the **F6F-5N**; production totalled 6,435 F6F-5Ns, while 252 F6F-3s and 930 F6F-5s served with the British Fleet Air Arm as the **Hellcat Mk I** and **Hellcat Mk II** respectively. Production of all F6Fs amounted to 12,275, and official figures credited the US Navy and Marine Corps aircraft with the destruction of 5,156 enemy aircraft in air combat, about 75 per cent of all the US Navy's air combat victories in the war. The Hellcat's greatest single victory was in that largest of all carrier operations, the Battle of the Philippine Sea, in which 15 American carriers embarked 480 F6F fighters (plus 222 dive-bombers and 199 torpedo-bombers); by the end of a week's fighting Task Force 58 had destroyed more than 400 Japanese aircraft and sunk three carriers. Hellcats were still serving with the US Navy several years after the war.



Grumman Hellcat Mk II of No. 800 Sqn, Fleet Air Arm, flying from HMS Emperor *off the coast of Malaya in September 1945. The Fleet Air Arm adopted US-style midnight blue in the Far East and some aircraft sported white bars each side of the national insignia.*

Grumman F6F Hellcat (continued)



Grumman F6F-6 Hellcat of VF-12, US Navy aboard USS Randolph *operating in Japanese waters in early 1945.*

Specification
Grumman F6F-5 Hellcat

Type: single-seat shipboard fighter

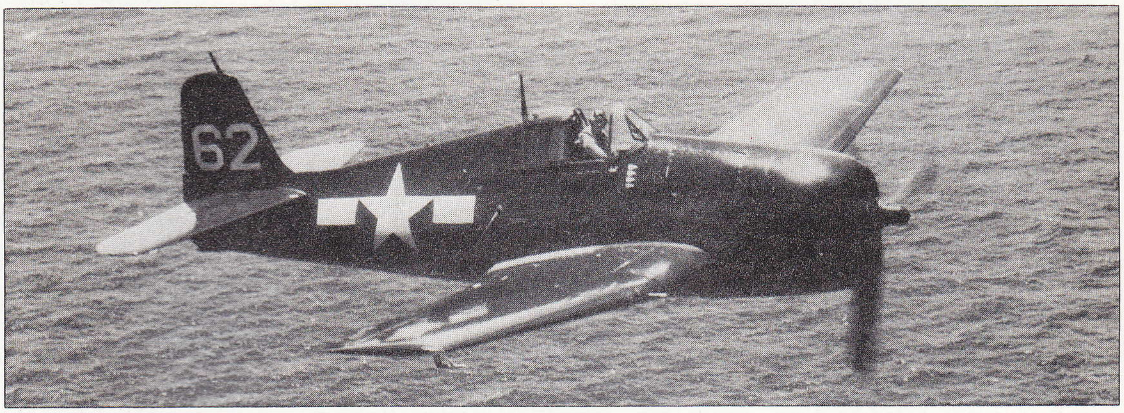
Powerplant: one 1491.4-kW (2,000-hp) Pratt & Whitney R-2800-10W radial piston engine

Performance: maximum speed 612 km/h (380 mph) at 7132 m (23,400 ft); initial climb rate 908 m (2,980 ft) per minute; service ceiling 11369 m (37,300 ft); range 1521 km (945 miles)

Weights: empty 4190 kg (9,238 lb); maximum take-off 6991 kg (15,413 lb)

Dimensions: span 13.05 m (42 ft 10 in); length 10.24 m (33 ft 7 in); height 3.99 m (13 ft 1 in); wing area 31.03 m^2 (334.0 sq ft)

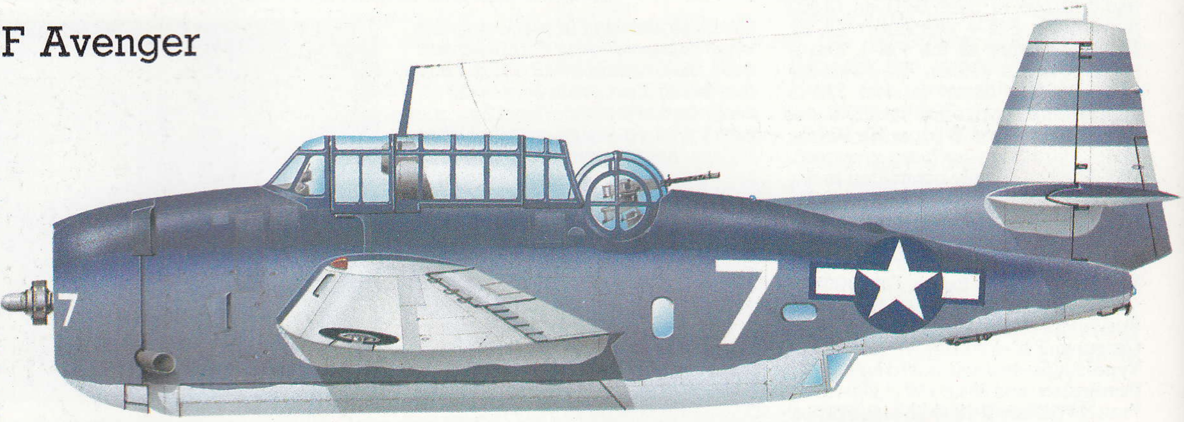
Armament: six 12.7-mm (0.5-in) machine-guns in wings, or two 20-mm cannon and four 12.7-mm (0.5-in) guns in wings, plus provision for two 454-kg (1,000-lb) bombs



The Hellcat finally enabled the Americans to defeat the Mitsubishi A6M. This VD-5 aircraft was used in the photo-reconnaissance role.

USA

Grumman TBF Avenger



Grumman TBF Avenger of the US Navy. Armament of the dorsal turret was one 0.5-calibre machine-gun.

Destined to become one of the best shipborne torpedo-bombers of the war, the **Grumman TBF-Avenger** first saw combat during the great Battle of Midway. The **XTBF-1** prototype was first flown on 1 August 1941 after an order for 286 aircraft had already been placed. The first **TBF-1** aircraft appeared in January 1942 and VT-8 ('Torpedo-Eight') received its first aircraft during the following May. On 4 June six of VT-8's aircraft were launched at the height of the Battle of Midway, but only one returned – and this with one dead gunner and the other wounded. Despite this inauspicious start, production was accelerating as General Motors undertook production in addition to Grumman, producing the **TBM-1** version. Sub-variants included the **TBF-1C** with two 20-mm cannon in the wings, the **TBF-1B** which was supplied to the UK under Lend-Lease, the **TBF-1D** and **TBF-1E** with ASV radar, and the **TBF-1L** with a searchlight in the bomb bay. Production of the TBF-1 and TBM-1, as well as sub-variants, were 2,290 and 2,882 respectively. General Motors (Eastern Divison) went on to produce 4,664 **TBM-3** aircraft with R-2600-20 engines, and the sub-variants corresponded with those of the TBF-1s. The UK received 395 TBF-1Bs and 526 TBM-3Bs, and New Zealand 63. The **TBM-3P** camera-equipped aircraft and the **TBM-3H** with search radar were the final wartime versions, although the Avenger went on to serve with the US Navy until 1954.

Specification
Grumman (General Motors) TBM-3E Avenger

Type: three-crew carrierborne torpedo-bomber

Powerplant: one 1416.8-kW (1,900-hp) Wright R-2600-20 radial piston engine

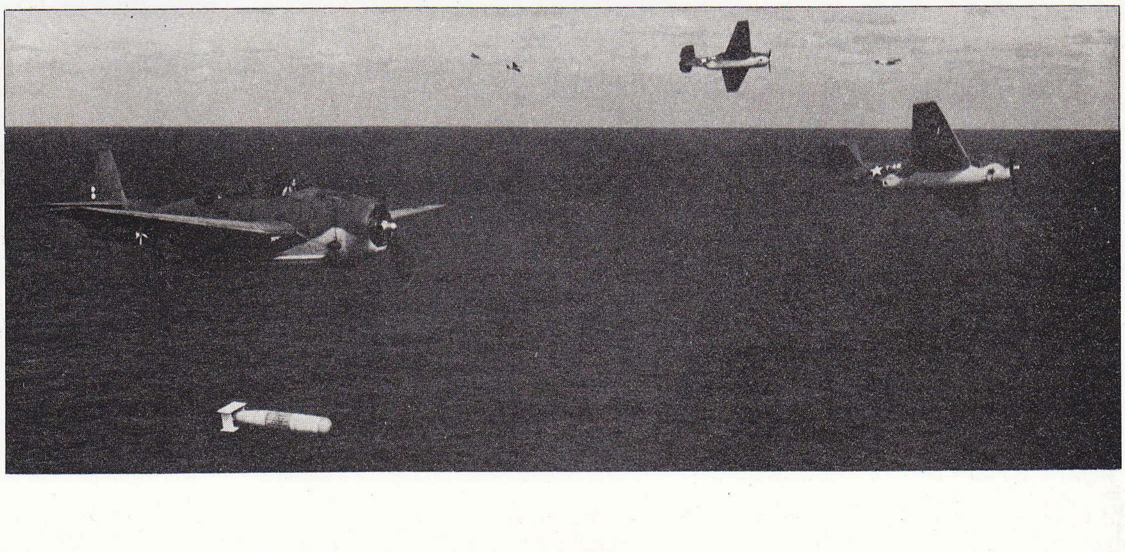
Performance: maximum speed 444 km/h (276 mph) at 5029 m (16,500 ft); initial climb rate 628 m (2,060 ft) per minute; service ceiling 9174 m (30,100 ft); range 1625 km (1,010 miles)

Weights: empty 4783 kg (10,545 lb); maximum take-off 8117 kg (17,895 lb)

Dimensions: span 16.51 m (54 ft 2 in); length 12.48 m (40 ft 11.5 in); height 4.70 m (15 ft 5 in); wing area 45.52 m^2 (490.0 sq ft)

Armament: two fixed forward-firing 12.7-mm (0.5-in) guns, one 12.7-mm (0.5-in) gun in dorsal turret and one 7.62-mm (0.3-in) gun in ventral position, plus an offensive load of up to 907 kg (2,000 lb) of bombs, or one torpedo, in weapons bay

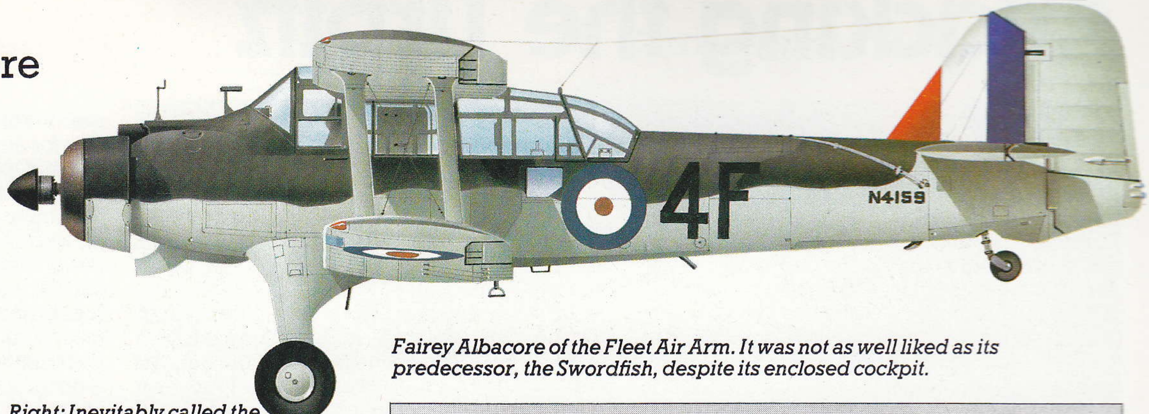
Avengers replaced the hopelessly outclassed Devastator on the torpedo squadrons from 1942 onwards. These Avengers are seen on a practice torpedo run.



UK

Fairey Albacore

Wholly eclipsed by the Swordfish, which it was intended to replace, the **Fairey Albacore** was in essence a cleaned-up version of the celebrated 'Stringbag' with an enclosed cabin to improve the operational efficiency of the crew and a Bristol Taurus radial to provide higher performance despite considerably greater weights. First flown in December 1938, the initial prototype was fitted with a wheel landing gear, while the second had twin floats. The Albacore, which was inevitably called the 'Applecore' in service, differed from the Swordfish in being used operationally only on the wheeled type of landing gear. The type entered service with the Royal Navy's Fleet Air Arm in 1940, and production amounted to 798 aircraft. The Albacore was first flown in action during attacks on Boulogne in September 1940. Most Albacores were land-based throughout their careers, but the type's brief moment of glory arrived when the Albacores from the carrier HMS *Formidable* severely damaged the Italian battleship *Vittorio Veneto* during the Battle of Cape Matapan in March 1941. After this time the Albacore was occasionally used for bombing in the Western Desert, usually at night to prevent the depredations of Axis fighters, and the type played an important part in the operations leading up to the Battle of Alamein in October 1942. In carrier operations the Albacore saw service in the North Atlantic, Arctic, Mediterranean and Indian oceans; and the type was also used with some success as a support aircraft during seaborne invasions, notably those of Sicily, Italy and northern France, the last in the hands of Royal Canadian Air Force squadrons.



Fairey Albacore of the Fleet Air Arm. It was not as well liked as its predecessor, the Swordfish, despite its enclosed cockpit.

Right: Inevitably called the 'Applecore', the Albacore gave good if undistinguished service, especially in North Africa and the Mediterranean. This aircraft is seen dropping a practice 457-mm (18-in) torpedo.

Specification

Fairey Albacore

Type: three-crew naval torpedo-bomber

Powerplant: one 794.2-kW (1,065-hp) Bristol Taurus II radial piston engine

Performance: maximum speed 259 km/h (161 mph) at 2134 m (7,000 ft); climb to 1829 m (6,000 ft) in 8.0 minutes; service ceiling 6309 m (20,700 ft); range 1320 km (820 miles)

Weights: empty 3266 kg (7,200 lb); maximum take-off 5715 kg (12,600 lb)

Dimensions: span 15.24 m (50 ft 0 in); length 12.13 m (39 ft 9.5 in); height 4.65 m (15 ft 3 in); wing area 57.88 m^2 (623.0 sq ft

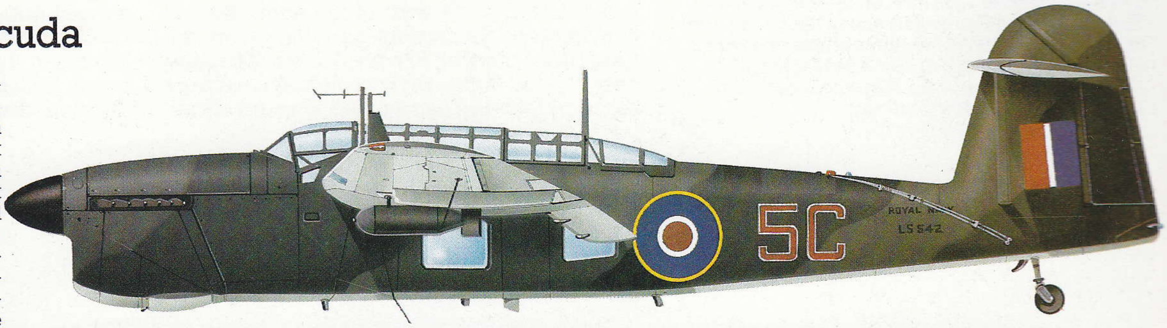
Armament: one forward-firing 7.7-mm (0.303in) Vickers machine-gun and two 7.7-mm (0.303-in) Vickers 'K' machine-guns in the rear cockpit, plus one 457-mm (18-in) torpedo or up to 907 kg (2,000 lb) of bombs

---

UK

Fairey Barracuda

Intended to replace the Albacore, itself a replacement for the Swordfish, the **Fairey Barracuda** was an altogether more advanced aircraft conceptually, and was designed as a high-performance monoplane to meet a 1937 requirement. The intended powerplant was the Rolls-Royce Exe, and the programme was delayed substantially when this engine was abandoned and the structure had to be revised to accommodate a Merlin engine from the same manufacturer. Thus the Barracuda prototype did not fly until 7 December 1940, and it was immediately apparent that the performance of the heavy Barracuda would be limited by the power available: the 939.6-kW (1,260-hp) Merlin XXX in the **Barracuda Mk I** and the 1222.9-kW (1,640-hp) Merlin 32 for the **Barracuda Mk II** and **Barracuda Mk III**. At a time when production priorities were afforded mostly to the RAF, deliveries of the Barracuda to the Fleet Air Arm were slow to start, and it was January 1943 before Barracuda Mk Is began to enter service with the Fleet Air Arm. The Barracuda Mk I was little more than a service-test type, only 23 being built. The two main wartime models were thus the Barracuda Mk II with ASV Mk IIN radar (1,635 built by Fairey, Blackburn, Boulton Paul and Westland) and the Barracuda Mk III torpedo-reconnaissance version with ASV Mk X radar (912 built by the parent company). The Barracuda saw only limited service in home waters, the highpoint of its career being a highly successful strike on the German battleship *Tirpitz* in April 1944; but in the Pacific campaigns of 1944 and 1945 the Barracuda was one of the more prominent British aircraft.



Fairey Barracuda Mk II of the Fleet Air Arm, complete with anti-submarine radar and underwing depth bombs.

Specification

Fairey Barracuda Mk II

Type: three-crew shipborne torpedo- and dive-bomber

Powerplant: one 1222.9-kW (1,640-hp) Rolls-Royce Merlin 32 V-12 piston engine

Performance: maximum speed 367 km/h (228 mph) at 533 m (1,750 ft); climb to 1524 m (5,000 ft) in 6.0 minutes; service ceiling 5060 m (16,600 ft); range 1851 km (1,150 miles)

Weights: empty 4241 kg (9,350 lb); maximum take-off 6396 kg (14,100 lb)

Dimensions: span 14.99 m (49 ft 2 in); length 12.12 m (39 ft 9 in); height 4.60 m (15 ft 1 in); wing area 34.09 m^2 (367.0 sq ft)

Armament: two 7.7-mm (0.303-in) Vickers 'K' machine-guns in the rear cockpit, plus one 735-kg (1,620-lb) torpedo, or four 204-kg (450-lb) depth charges, or six 113-kg (250-lb) bombs

Altogether more advanced than the Albacore, the Barracuda was delayed by difficulties with engine-mounting. When it did reach service in January 1943, the aircraft acquitted itself well, especially during the attacks on Tirpitz.

Attacking the Tirpitz

Following the sinking of the **Bismarck**, ***the British turned their attention to her sister, the*** **Tirpitz**. ***It took another three and a half years before she was sunk by RAF Lancasters, but in the meantime she was attacked time and time again by aircraft of the Fleet Air Arm.***

The final sinking of the German battleship *Tirpitz* is credited to the RAF's 'Dambusters', the Avro Lancasters of No. 617 Squadron, accompanied by the similarly equipped No. 9 Squadron, who put paid to her in November 1944. It is debatable, however, whether she would have been available to them as a static target had it not been for the earlier efforts of the Fleet Air Arm.

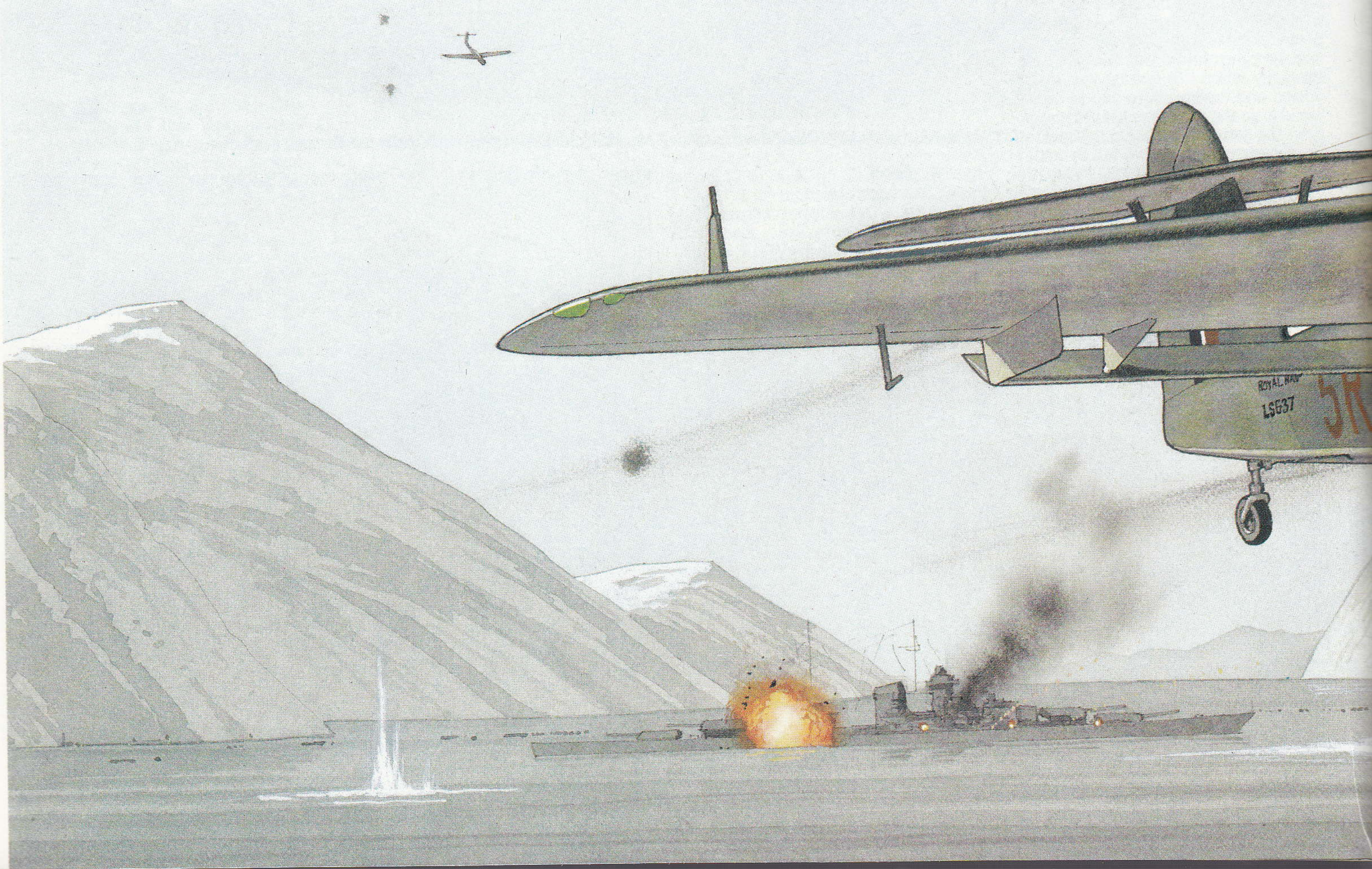
Following the sinking in May 1941 of her sistership *Bismarck*, the *Tirpitz* became the primary headache of the British Admiralty, who feared that she too might break out to raid Atlantic and Arctic convoys. That this fear was well founded was amply demonstrated in March 1942 when she left her refuge in Trondheim whilst convoy PQ.12 was bound from Iceland to the USSR. During the morning of 9 March, a spotting aircraft from HMS *Victorious* sighted the enemy ship, and a strike was mounted by Fairey Albacores of Nos 817 and 832 Squadrons. All succeeded in dropping their torpedoes, but none found the target, and two of the attacking aircraft failed to return. This was destined to be the Fleet Air Arm's first and only chance of finding the *Tirpitz* on the open sea. She made one further foray in July 1942 for an intended attack on the ill-fated convoy PQ.17, but hastily returned to Norway after learning that HMS *Victorious* was once again with the Home Fleet.

The next attack on *Tirpitz* was to have been made at her moorings in Altenfjord early in 1943 by Swordfish from HMS *Dasher*, but that escort carrier blew up near the Isle of Arran on 27 March, many lives being lost. It was not until a year later that a fresh strike could be mounted, but by this time more modern equipment was available in the shape of the Fairey Barracudas of the 9th and 52nd Naval Torpedo Bomber Reconnaissance Wings. Simulated attacks were carried out during March 1944 on a dummy target in Loch Eriboll in north west Scotland; then the wings regrouped their squadrons for the actual attack. HMS *Furious* was to embark Nos 830 and 831 Squadrons with nine aircraft each for the operation, whilst Nos 827 and 829 Squadrons had 12 aircraft each in HMS *Victorious*.

Midget sub attack

The *Tirpitz* had been damaged six months earlier in an attack by midget submarines as she lay at anchor in Kaafjord, but was ready for sea running trials in Altenfjord at the beginning of April 1944. However, by the early morning of 3 April the two fleet carriers were with the Home Fleet Battle Squadron, only 193 km (120 miles) to the north west of the fjord. Accompanying the fleet carriers were the escort carriers HMS *Emperor*, *Fencer*, *Pursuer* and *Searcher*, the first three with two fighter squadrons each, and the last named with a mixed squadron of Fairey Swordfish and Grumman Wildcats for anti-submarine and fighter defence. At 04.24, Operation 'Tungsten' began with the launch of the Barracudas of the 8th TBR Wing, accompanied by an escort of 40 fighters. They arrived at the fjord just as the enemy ship was ready for departure, the escorting Wildcats and Grumman Hellcats appearing over the surrounding hills to machine-gun the target, whilst the Vought Corsairs remained at height in case German fighters should appear. With the element of surprise, all the Barracudas were able to make an attack, and they succeeded in making six direct hits on the stationary target. A further attack an hour later by the other TBR wing was less fortunate, a smoke screen having been laid in the meantime, but nevertheless they claimed a further eight hits as well as some probables. The crews were too weary to carry out a proposed follow-up attack the following day, and this was consequently cancelled.

Further attacks were then planned, but these were dogged by ill luck. A raid on 26 April was cancelled because of poor weather conditions, another on 15 May was recalled after take off as a result of reports of heavy cloud over the target, and bad weather caused yet another cancellation on 28 May. The next effective attack was therefore that carried out on 17 July under the codename Operation 'Mascot'. Nos 827 and 830 Squadrons again participated, but this time from HMS *Formidable*, accompanied by the 9th TBR Wing comprising Nos 820 and 826 Squadrons aboard HMS *Indefatigable*. On this occasion a single strike was carried out, by 44 Barracudas, accompanied by 48 fighters, but the element of surprise was lost when the strike force was spotted from a newly-built mountaintop observation post. This enabled the enemy to lay a dense smoke-



Of all the Fleet Air Arm aircraft used against the **Tirpitz** ***it was the Fairey Barracuda which bore the brunt of the attack. Barracudas scored many hits on the battleship, effectively crippling it and rendering it immobile for the Lancasters of the RAF to finish it off with 'Tallboys'.***

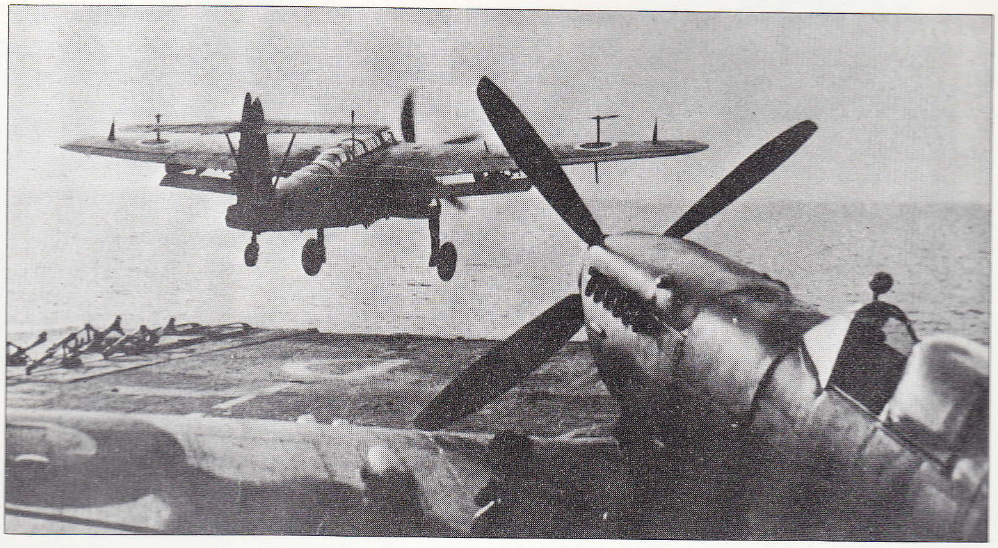
screen, and as a consequence only one near-miss was recorded.

Barracudas were again the main striking force in Operation 'Goodwood' in late August. The *Formidable* carried Nos 826 and 827 Squadrons, while *Furious* had No. 827 Squadron and the *Indefatigable* had No. 820 Squadron, all three ships carrying fighter escort, comprising Corsairs, Supermarine Seafires, Hellcats and Fairey Fireflies. In addition Grumman Avengers and Wildcats were carried in the escort carriers HMS *Nabob* and *Trumpeter*. The first strike ('Goodwood I') on 22 August proved fruitless as a result of further bad weather, and an evening strike by Hellcats ('Goodwood II') was also abortive. The force was reduced that day when the *Nabob* fell victim to an acoustic torpedo launched by *U-354*, though she succeeded in reaching port eventully after struggling more than 1609 km (1,000 miles) in a listing condition.

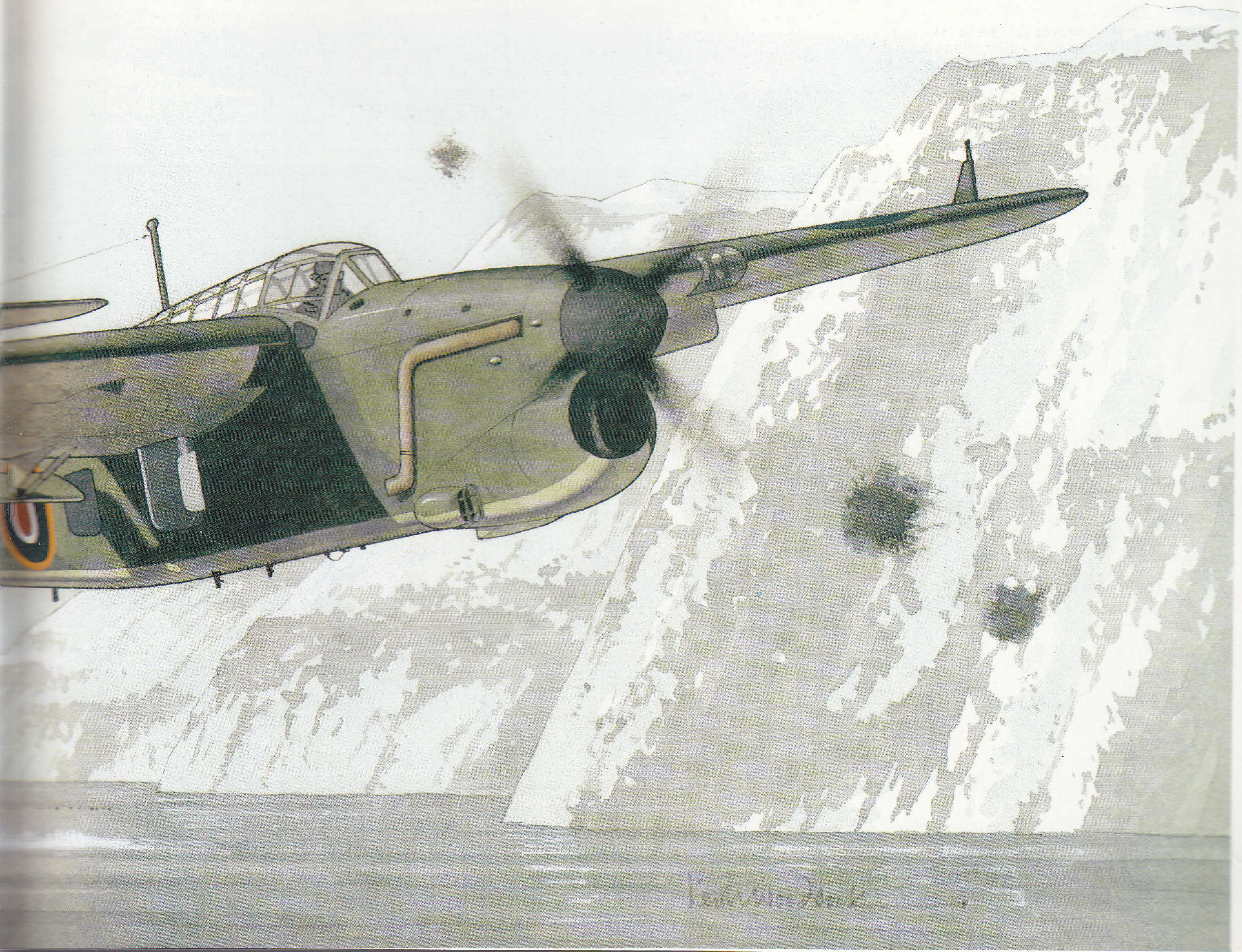
'Goodwood III'

More successful was 'Goodwood III' on 24 April. In this attack each of the 33 participating Barracudas carried a 726-kg (1,600-lb) armour-piercing bomb, whilst some of the Corsairs and Hellcats had 227-kg (500-lb) bombs. Once again the enemy had sufficient warning to put up a smokescreen, but undaunted by this the attackers dived in from various directions to confuse the AA gunners. Despite all the difficulties, one large and one small bomb found their target, but although the former penetrated the armoured decking, it failed to explode. The Fleet Air Arm's best opportunity of disabling or even sinking the ship was thus lost. A final raid on 29 August ('Goodwood IV') was once more frustrated by a smoke screen, and no hits were recorded in the resulting blind attack.

The fate of the *Tirpitz* was finally sealed on 12 November 1944, when RAF Lancasters dropped 28 'Tallboy' bombs, each weighing 5443 kg (12,000 lb). At least two of these scored direct hits, and the ship capsized.



***Displaying its most ungainly lines, extended dive-flaps and strange undercarriage, a Barracuda leaves the catapult. The type in the foreground, the Supermarine Seafire, provided fighter cover (along with Hellcats and Corsairs) for the Barracuda during the attacks on the* Tirpitz.**

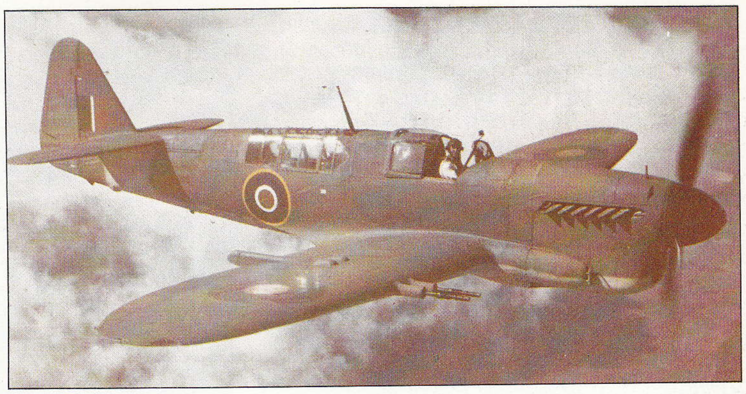


UK

Fairey Firefly

Numbered amongst the most successful aircraft ever used by the Fleet Air Arm, the **Fairey Firefly** served in its various versions for nearly 15 years, a total of 1,702 being produced before production ceased in 1956. The prototype took the air on 22 December 1941, and the first production **Firefly F.Mk I** entered service in March 1943. Later production Mk Is were fitted with ASH radar, in which form they became **Firefly FR.Mk I** reconnaissance fighters. A number of aircraft were produced as **Firefly NF.Mk I** night-fighters equipped with a different radio for night flying, and with shrouded exhausts. Another night-fighter version, the **Firefly NF.MK II**, had AI.Mk X radar mounted on each wing, whilst the **Firefly F.Mk IA** was a modification of the Mk I brought up to FR.Mk I standard by the addition of ASH radar. A trial modification fitted with a Griffon 61 and a nose radiator was designated **Firefly F.Mk 3**, but this was superseded by the **Firefly FR.Mk 4** reconnaissance fighter with a Griffon 74. This went into service in 1946, but from 1948 it gave way to variants of the **Firefly Mk 5** with improved equipment, the surviving FR.Mk 4s being converted to **Firefly TT.Mk 4** target tugs. Then followed the **Firefly AS.Mk 6** anti-submarine reconnaissance and strike aircraft, the final version to enter first-line service, of which 152 were delivered as such, including some converted from Mk 5s on the production line, in addition to many other Mk 5s converted after seeing service. Other versions of the Firefly included trainers and target drones, the last to appear being the **Firefly U.Mk 9** drone in 1956.

The Firefly was an immediate success on entering service, participating in attacks on the German battleship *Tirpitz* as well as taking part in numerous Norwegian raids. It was equally successful in the Pacific, making raids against Japanese occupied islands early in 1945, and against the Japanese mainland shortly before VJ-day. In the post-war years several squadrons took an active part in the Korean War, and one squadron later carried out attacks against Malayan bandits.



Fairey Firefly Mk Is reached squadron service in October 1943, and were soon active against such targets as the Tirpitz. A transfer to the Far East saw more action for the Fulmar, it was hampered by its size and two-man crew.

Specification

Fairey Firefly F.Mk I

Type: two-seat carrierborne fighter

Powerplant: one 1294-kW (1,735-hp) Rolls-Royce Griffon IIB V-12 piston engine

Performance: maximum speed 509 km/h (316 mph) at 4267 m (14,000 ft); service ceiling 8534 m (28,000 ft); range 2092 km (1,300 miles)

Weights: empty 4423 kg (9,750 lb); maximum take-off 6359 kg (14,020 lb)

Dimensions: span 13.56 m (44 ft 6 in); length 11.46 m (37 ft 7 in); height 4.14 m (13 ft 7 in); wing area 30.47 m^2 (328.0 sq ft)

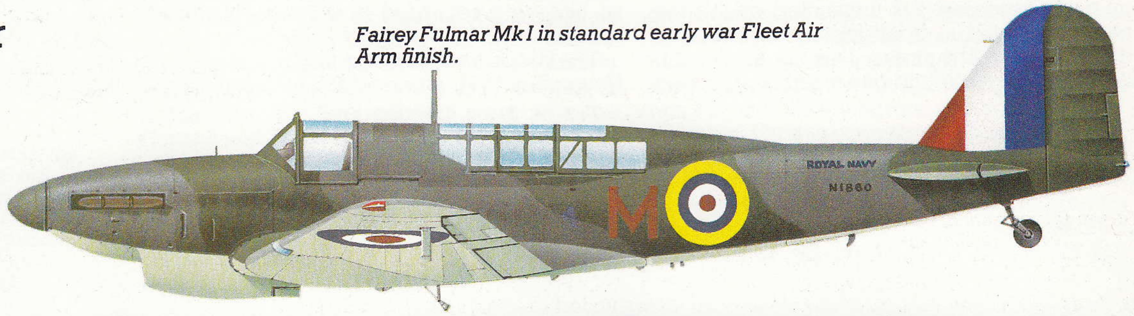
Armament: four 20-mm cannon, plus eight 27.2-kg (60-lb) rockets or two 454 (1,000-lb) bombs

---

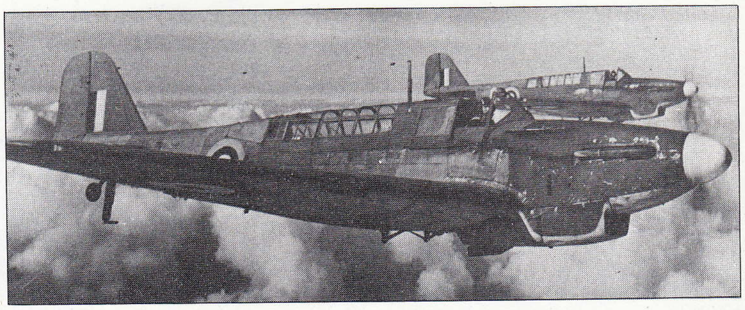
UK

Fairey Fulmar

The first true shipborne monoplane fighter for the Fleet Air Arm, the eight-gun **Fairey Fulmar** tends to be overlooked in the part it played in the first three years of the war, until replaced by deck-operating adaptations of the Hurricane and Spitfire, and by the Martlet. Developed from the Fairey P.4/34 light bomber prototypes which flew in 1937, the Fulmar fleet fighter prototype was flown on 4 January 1940, with production aircraft being completed soon after. Early trials showed the aircraft to have a disappointing performance, although it was recognized as being a fairly large aeroplane with the same engine as the Hurricane single-seater. In 1942, after 127 production **Fulmar Mk 1** fighters had been completed, the **Fulmar Mk II** appeared with 939.6-kW (1,260-hp) Merlin XXX, an engine which raised the top speed to 438 km/h (272 mph). Fulmar Mk Is of No. 808 Squadron of the Fleet Air Arm were listed in RAF Fighter Command's order of battle during the Battle of Britain, although they were not engaged in combat. By November 1940, however, Fulmars were in action from HMS *Illustrious* at the time of the Battle of Taranto, and soon afterwards from *Ark Royal* defending the vital convoys sailing to Malta. At the Battle of Cape Matapan Fulmars from *Formidable* escorted the Albacores and Swordfish which torpedoed the Italian battleship *Vittorio Veneto*. Early in 1942, as Japanese naval forces sailed into the Indian Ocean to threaten Ceylon, two squadrons of Fulmars were based there as part of Colombo's air defences; when confronted for the first time by the much superior carrierbased Mitsubishi A6M fighters the Fulmars were utterly outclassed and almost all were shot down or damaged. A total of 450 Fulmar Mk IIs was built, and some served as night-fighters.



Fairey Fulmar Mk I in standard early war Fleet Air Arm finish.



Right: Although powered by the same Merlin engine as the Hurricane and Spitfire, the Fulmar was considerably larger and carried an extra crew member. It was not the equal of the best enemy fighters, but gave a good account of itself.

Specification

Fairey Fulmar Mk II

Type: two-seat carrierborne fighter

Powerplant: one 939.6-kW (1,260-hp) Rolls-Royce Merlin XXX V-12 piston engine

Performance: maximum speed 438 km/h (272 mph) at 5029 m (16,500 ft); initial climb rate 402 m (1,320 ft) per minute; service ceiling 8291 m (27,200 ft); range 1255 km (780 miles)

Weights: empty 3349 kg (7,384 lb); maximum take-off 4627 kg (10,200 lb)

Dimensions: span 14.14 m (46 ft 4.5 in); length 12.24 m (40 ft 2 in); height 3.25 m (10 ft 8 in); wing area 31.77 m^2 (342.0 sq ft)

Armament: eight 7.7-mm (0.303-in) machine-guns in wings, and a few aircraft also had a single trainable 7.7-mm (0.303-in) machine-gun in the rear cockpit

---

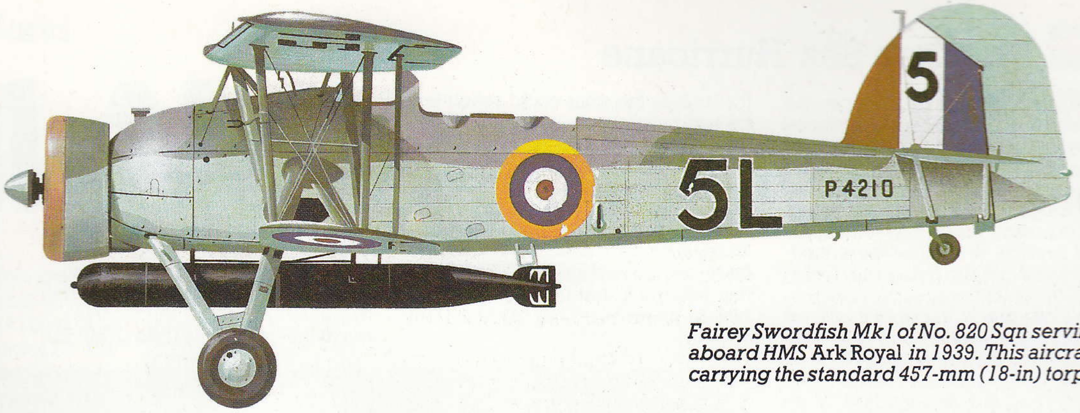
UK

Fairey Swordfish

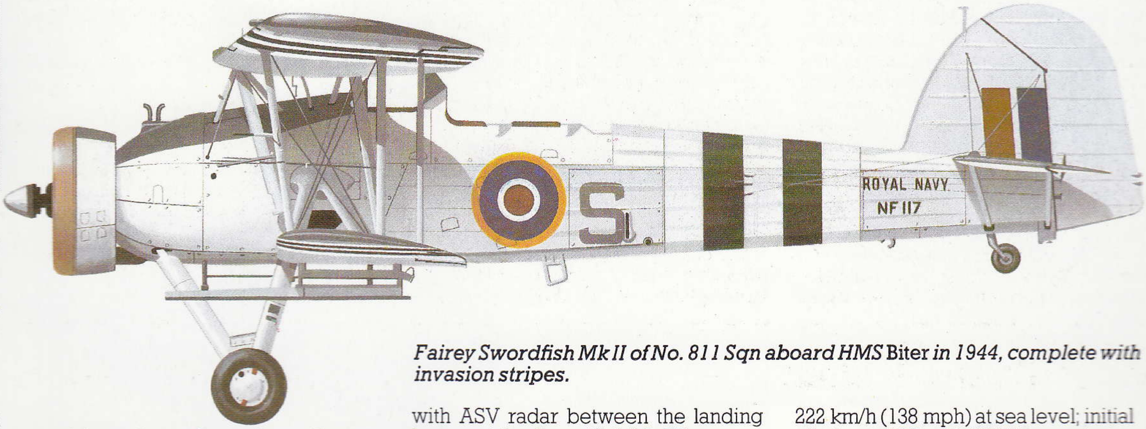
Of all aircraft regarded as anachronisms the **Fairey Swordfish** torpedo-bomber must be the supreme example, for even back in the 1930s it appeared archaic and cumbersome. Stemming from an earlier design whose prototype had crashed, the first prototype Swordfish (the **TSR.II**) first flew on 17 April 1934 and the production **Swordfish Mk I** was prepared to Specification S.38/34 with slightly swept-back top wing; construction was all-metal with fabric covering. By the outbreak of war in 1939 a total of 689 aircraft had been delivered or were on

A Fairey Swordfish Mk II is 'struck down' following an anti-submarine patrol.

Throughout the later months of the war, Swordfish were used on general attacks against German shipping in the North Sea. These were often small vessels and their light defences proved inadequate against the tough Swordfish. Rockets were the favoured weapon for these strikes.



Fairey Swordfish Mk I of No. 820 Sqn serving aboard HMS Ark Royal *in 1939. This aircraft is carrying the standard 457-mm (18-in) torpedo.*



Fairey Swordfish Mk II of No. 811 Sqn aboard HMS Biter *in 1944, complete with invasion stripes.*

order, serving with both wheel and float landing gear aboard Royal Navy carriers, battleships, battle-cruisers and cruisers in the torpedo-spotter reconnaissance role. Among the memorable events in which the old 'Stringbag' participated was the action at Taranto on 11 November 1940, when Swordfish aircraft from HMS *Illustrious* severely damaged three Italian battleships; the crippling of the *Bismarck* in the Atlantic; and the suicidal attack on the German warships, *Scharnhorst, Gneisenau* and *Prinz Eugen* during their famous escape up the English Channel in February 1942. Production of the Swordfish was undertaken largely by Blackburn, the **Swordfish Mk II** being introduced with a strengthened lower wing to allow eight rocket projectiles to be mounted, the **Swordfish Mk III** with ASV radar between the landing legs, and the **Swordfish Mk IV** conversion of the Mk II with a rudimentary enclosed cabin. Production ended on 18 August 1944, by which time a total of 2,396 Swordfish had been completed.

Specification

Fairey Swordfish Mk II

Type: three-crew torpedo/anti-submarine aircraft

Powerplant: one 559.3-kW (750-hp) Bristol Pegasus XXX radial piston engine

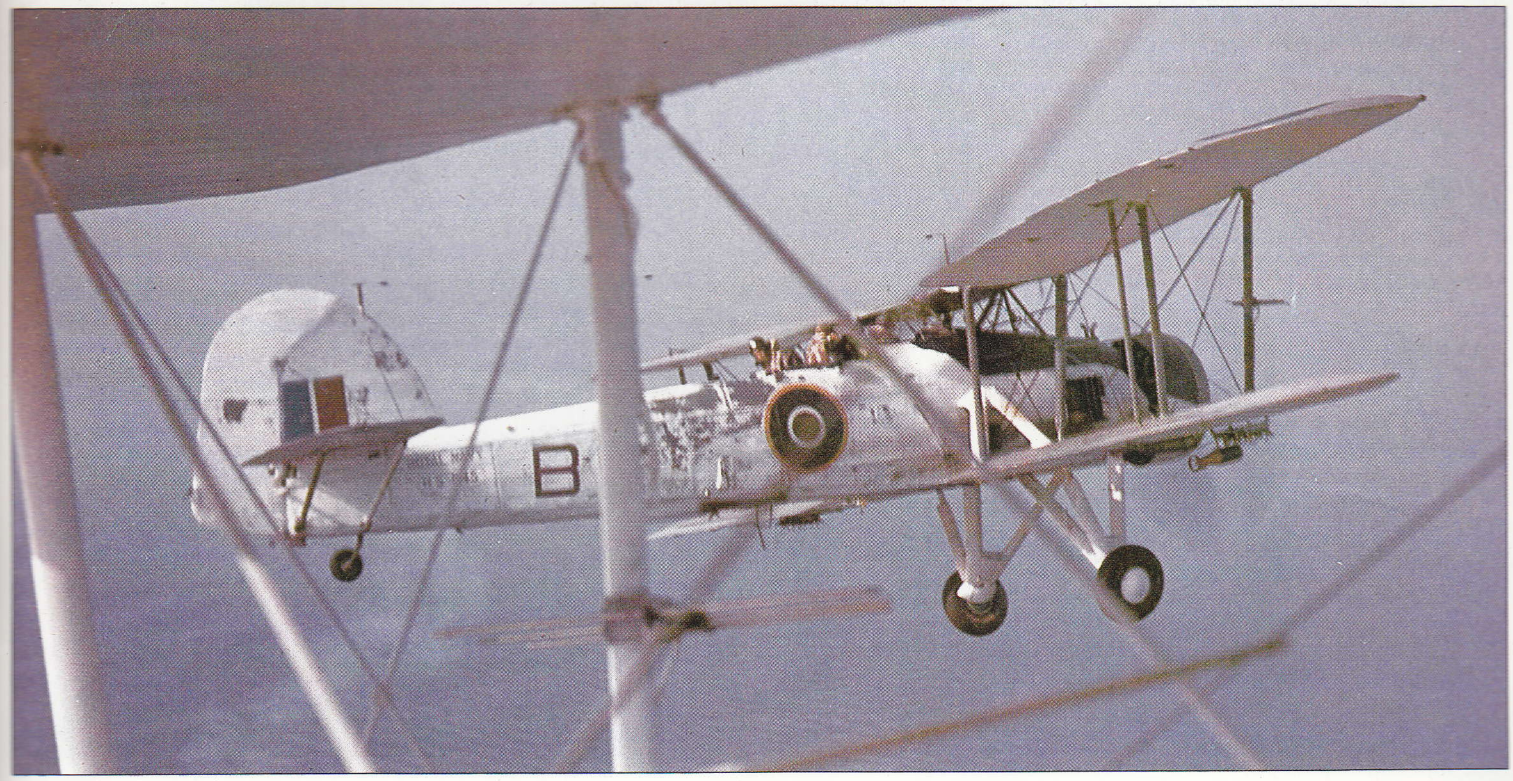
Performance: maximum speed 222 km/h (138 mph) at sea level; initial climb rate 372 m (1,220 ft) per minute; service ceiling 5867 m (19,250 ft); range 879 km (546 miles)

Weights: empty 2132 kg (4,700 lb); maximum take-off 3406 kg (7,510 lb)

Dimensions: span 12.87 m (45 ft 6 in); length 10.87 m (35 ft 8 in); height 3.76 m (12 ft 4 in); wing area 56.39 m^2 (607.0 sq ft)

Armament: one fixed forward-firing 7.7-mm (0.303-in) machine-gun and one trainable 7.7-mm (0.303-in) gun in rear cockpit, plus an offensive load of one 457-mm (18-in) torpedo or eight 27.2-kg (60-lb) rocket projectiles

Seemingly an anachronism in World War II, the Swordfish remained unmatched by any other British naval aircraft in terms of battle honours. At the heart of this was the aircraft's immense sturdiness and basic good design. This typically well-worn example is carrying a practice bomb.



UK

Hawker Sea Hurricane

Based on the RAF's Hurricane, the **Hawker Sea Hurricane** was introduced to provide modern fighter protection for convoys of merchant ships. Over 800 were delivered, the majority of them being conversions of Hurricanes, including many which had seen operational service. A number were modifications of newly delivered Canadian-built aircraft.

The first version to appear was the **Sea Hurricane Mk IA** fitted with catapult spools so that they could be flown from specially fitted merchant ships in the event of the appearance of an enemy aircraft. This was followed by the **Sea Hurricane Mk IB**, which in addition to the spools had deck arrester gear to enable it to be used for carrier operations. The **Sea Hurricane Mk IC**, of which only a few were produced, had four wing-mounted 20-mm cannon in place of the machine-guns of the earlier versions. Re-engined with the Rolls-Royce Merlin XX it became the **Sea Hurricane Mk IIB** when fitted with machine-guns, and the **Sea Hurricane Mk IIC** with cannon. Canadian-built aircraft also used these designations, irrespective of their original mark numbers.

Sea Hurricanes first entered operational service in February 1941 with No. 804 Squadron for deployment from catapult-armed merchantmen, or CAM-ships as they were generally known. The first carrier squadron to equip was No. 880 Squadron in March 1941, seeing action in July from HMS *Furious* during a raid on the Arctic port of Petsamo. The following month an aircraft of No. 804 Squadron catapulted from HMS *Maplin* accounted for a Focke-Wulf Condor. The disadvantage of this method of operation was that unless the pilot could reach land he had no choice but to ditch his aircraft. The CAM-ship task and aircraft were later passed on to the RAF's Merchant Ship Fighter Unit at Speke. When the first escort carriers came into service with the Royal Navy, Sea Hurricanes were attached to several of them, seeing service in the Arctic and the Mediterranean until being replaced in 1943 by Seafires and Wildcats.

Specification
Hawker Sea Hurricane Mk IIC
Type: carrierborne fighter
Powerplant: one 954.5-kW (1,280-hp) Rolls-Royce Merlin XX V-12 piston engine
Performance: maximum speed 505 km/h (314 mph) at 5944 m (19,500 ft); service ceiling 10516 m (34,500 ft); range 1207 km (750 miles)
Weights: empty 2617 kg (5,770 lb); maximum take-off 3511 kg (7,740 lb)
Dimensions: span 12.20 m (40 ft 0 in); length 9.83 m (32 ft 3 in); height 4.00 m (13 ft 1.5 in); wing area 23.92 m^2 (257.5 sq ft)
Armament: four 20-mm cannon

After the failure of such types as the Sea Gladiator and Fulmar to provide adequate fighter protection, the Hurricane was hastily adapted for carrier decks. The result was a fine fighter which saw much action.

UK

Supermarine Seafire

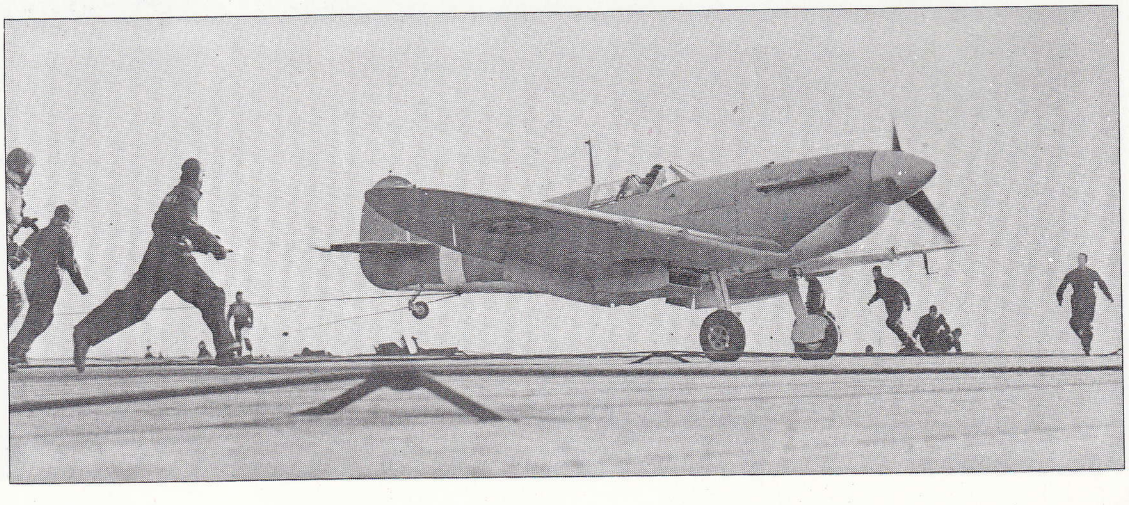
Following the success of the Sea Hurricane adaptation, a Spitfire VB was fitted with a 'V' arrester hook and satisfactory trials were carried out in HMS *Illustrious* towards the end of 1941. A number of these aircraft with 'B' type wings were similarly modified and named **Supermarine Seafire Mk IB**. In May 1942 the **Seafire Mk IIC** began to come off the production line, fitted with the 'C' type Spitfire wing with provision for four 20-mm cannon, and having a reinforced fuselage, catapult spools and rocket-assisted take-off gear (RATOG). A low-altitude version was the **Seafire L.Mk IIC**, and a few were fitted with cameras for photographic reconnaissance work, being designated **Seafire LR.Mk IIC**. A manually-operated folding wing was introduced on the **Seafire F.Mk III**, and as with the earlier mark there was a **Seafire L.Mk III** variant for low-altitude work, a few being modified as the **Seafire LR.MK III** for photo-reconnaissance duties.

In 1945 the Griffon-engined Seafire **F.Mk XV** appeared, with a sting-type arrester hook, being followed by the **Seafire F.Mk XVII** with a clear-view bubble hood, cutaway rear fuselage and increased fuel capacity. The **Seafire FR.Mk XVII** reconnaissance variant had two cameras. Based on the Spitfire F.Mk 21, the **Seafire F.Mk 45** had a later Griffon fitted with either a five-blade propeller or two three-blade counter-rotating propellers. The clear-view bubble hood and cutaway rear fuselage were fitted to the **Seafire F.Mk 46**, a reconnaissance version being the **Seafire FR.Mk 46**. The final version, the **Seafire F.Mk 47**, and the **Seafire FR.Mk 47** variant, had power-folding wings and other changes.

The Seafire participated successfully in the North African landings in November 1942, and later at Salerno and the south of France. Its principle failing was highlighted at Salerno, where lack of windspeed over the carrier decks led to numerous collapsed landing gears. Several squadrons were active in the Pacific, and after the war the Griffon-engined versions remained in service until 1954, many with reserve squadrons.

Specification
Supermarine Seafire F.Mk III
Type: carrierborne fighter
Powerplant: one 1096-kW (1,470-hp) Rolls-Royce Merlin 45, 50 or 55 V-12 piston engine
Performance: maximum speed 566 km/h (352 mph) at 3734 m (12,250 ft); service ceiling 10302 m (33,800 ft); range 748 km (465 miles) on internal fuel
Weights: empty 2449 kg (5,400 lb); maximum take-off 3175 kg (7,000 lb)
Dimensions: span 11.23 m (36 ft 10 in); length 9.12 m (29 ft 11 in); height 3.48 m (11 ft 5 in); wing area 22.48 m^2 (242.0 sq ft)
Armament: two 20-mm cannon and four 7.7-mm (0.303-in) machine-guns, plus provision for one 227-kg (500-lb) bomb or two 113-kg (250-lb) bombs

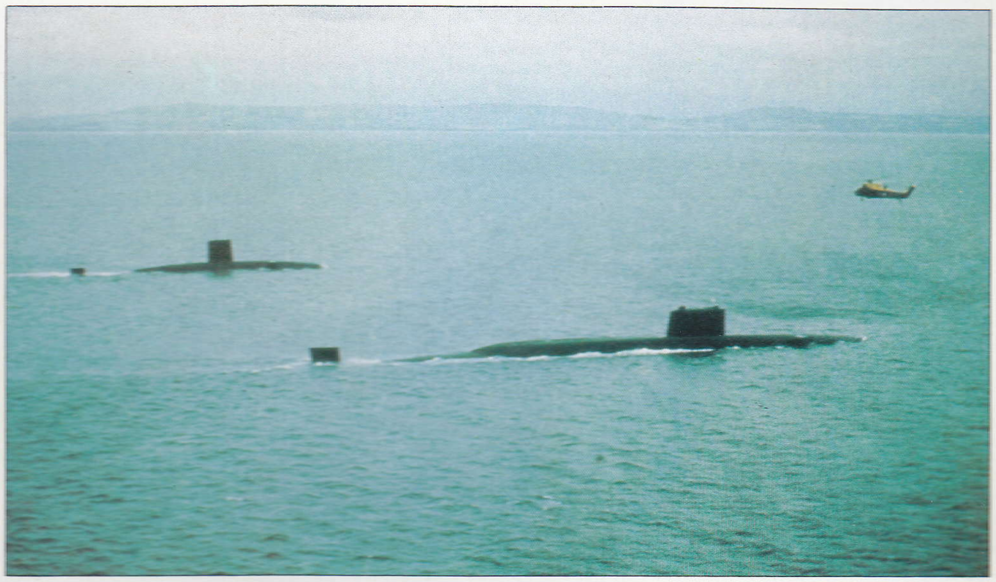
Seafires were potent fighters with high performance for a deck-launched aircraft but suffered a great deal from weak undercarriages and relatively high landing speed.



Armed Forces of the World

Royal Navy

Part 1



Seen in the Clyde estuary with the nuclear-powered fleet submarine HMS Churchill, *the nuclear-powered ballistic missile submarine HMS* Renown *is armed with 16 Polaris A3 missiles, each with three 60-kiloton 'Chevaline' warheads. The Polaris system will be replaced by Trident during the 1990s.*

The Royal Navy currently has worldwide capabilities, but because of political commitments concentrates its main strength in support of NATO's Eastern Atlantic (EASTLANT) area of operations. In the last couple of years, however, this support has been diluted by the need to maintain a task group (with an SSN in support) in the South Atlantic to protect the Falkland Islands from any further Argentine aggression. Moreover, the Royal Navy is still suffering from the effects of the ill-conceived 1981 Defence Review and the salutary lessons dealt to it during the 1982 war by the Argentine air force and naval air arm. The closure of one naval dockyard and the reduction of another to fleet maintenance base status has placed considerable strain on the Royal Navy's support infrastructure for the refitting of warships and auxiliaries, which has resulted in a number of vessels now being refitted in commercial yards. Unfortunately this makes such ships much more vulnerable to external influences (such as strikes), which compounds the problems yet further. The slow but sure orientation of the Royal Navy to counter the Soviet ASW (anti-submarine warfare) threat whilst maintaining the minimum credible nuclear deterrent force of SLBM (submarine-launched ballistic missile) submarines is also reducing the Royal Navy's capabilities, and the overall reduction of surface ship numbers also testifies to this tendency.

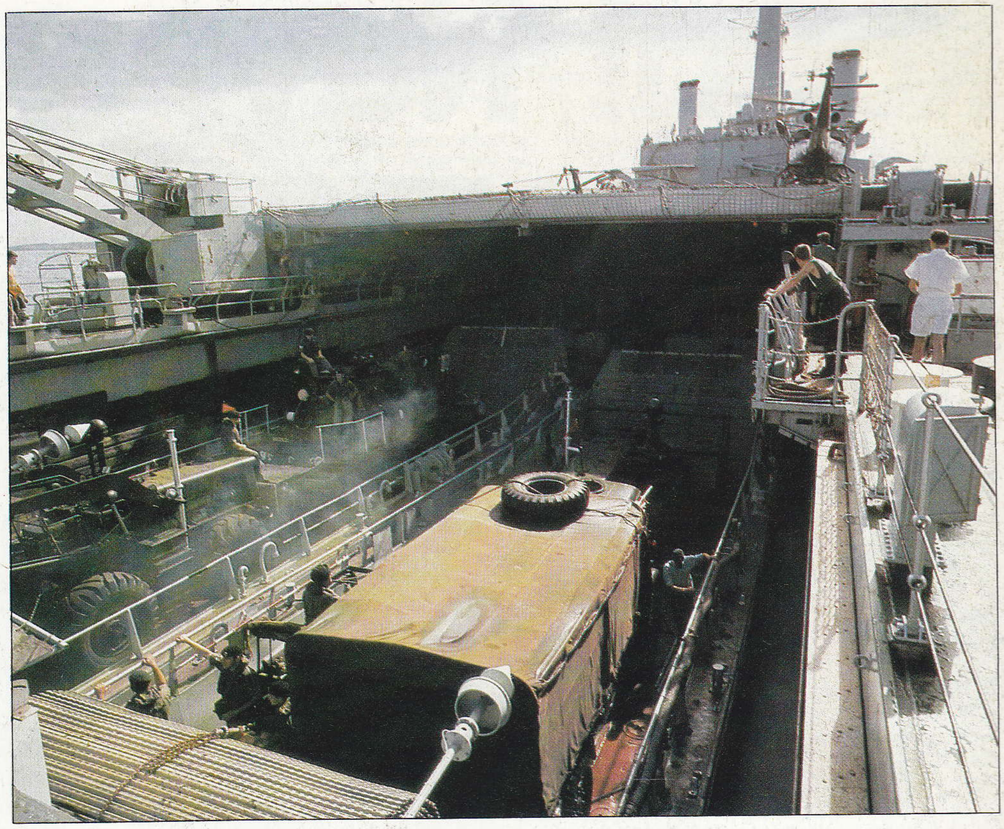
However, to fulfil the peacetime and wartime roles assigned to it, the Royal Navy has evolved over many years a command structure that is geared to the flexibility needed to carry out such tasks. The surface fleet of destroyers and frigates is divided into two flotillas each commanded by a flag officer. At present the Flag Officer Flotilla One (FOF1) flies his flag in a 'County' class destroyer and has under his command the 3rd Destroyer Squadron with the 1st, 6th and 7th Frigate Squadrons, whilst FOF2 flies his flag in the other 'County' class destroyer available and has the 5th Destroyer and the 2nd, 4th and 8th Frigate Squadrons available. The major surface combatants of the Royal Navy and the sole ice patrol ship HMS *Endurance*, together with most of the naval air assets afloat, is the concern of FOF3, who is also commander of NATO's ASW Group Two in wartime, with the prime responsibility of protecting the US carrier battle group formations of NATO's Strike Fleet in their forays into the northern flank area.

Independent of the FOFs is the Flag Officer Submarines (FOSM), who exercises on behalf of the Commander-in-Chief Fleet (CINCFLEET) the operational command and tasking of all the subsurface craft bar the 10th Submarine Squadron of SSBNs during their operational cycle. These remain exclusively under CINCFLEET control whilst on patrol. FOSM has under his command the 1st Submarine Squadron of conventional boats at Portsmouth, the 2nd Submarine Squadron of fleet submarines at Devonport and the 3rd Submarine Squadron (a mixture of boats) at Faslane. The problem of mine countermeasures is addressed by the 1st, 2nd, 3rd and 10th (RNR) Squadrons of the Mine Countermeasures Flotilla, with the individual units assigned to the flag officers of the various naval operational zones within the United Kingdom region.

Submarines and major surface vessels

At present the deterrent force of the UK devolves upon the continuous presence of one or more of the 'Resolution' class SSBNs (strategic missile submarines, nuclear-powered) on submerged patrol. Armed with the Polaris A3 missile with three 60-kiloton 'Chevaline' warheads with advanced decoys and penetration aids to defeat Soviet ABM defences, each submarine can engage up to 16 separate targets at ranges up to 4627 km (2,875 miles) with a high kill probability. To enhance the deterrent into the 21st century the first of a class of four 'V' class Trident SSBNs will commission in 1994 to replace the Polaris boats on a one for one basis. Armed with 16 Trident D5 missiles, each carrying eight independently targeted 100-kiloton yield warheads over 9600-km (5,965-mile) range, these new SSBNs will be protected by a growing force of fleet SSNs (attack submarines, nuclear-powered). The oldest boats in the force are five 'Valiant' and 'Churchill' class vessels, which are backed up by six modern 'Swiftsure' class boats and a growing number of the anechoic sound-absorbing tile-coated 'Trafalgar' class SSNs. They are armed with the 22-km (13.7-mile) range 35-kt Mk 24 Model 1 Tigerfish dual ASW/anti-ship wire-guided torpedo, together with Mk 8 anti-ship torpedoes and Sub-Harpoon underwater-launched sea-skimming anti-ship missiles. In the late 1980s the Tigerfish will be supplemented by the new 60+ kt Spearfish heavyweight dual-role torpedo and a new long-range underwater-launched guided ASW missile that will carry a Stingray lightweight torpedo derivative as its payload.

HMS Invincible, *the first of her class of VTOL aircraft carriers, leaves port during a visit to the United States. The newly-installed Phalanx 20-mm Close-in Weapon System is prominent in its position on the flight deck.*



A laden utility landing craft (LCU) is manoeuvred within the docking well of the amphibious assault ship HMS Intrepid. _With HMS_ Fearless, Intrepid _provides almost all the Royal Navy's amphibious capability._

To support the fleet submarines in their operations and to provide a submarine force capable of operating effectively in the continental-shelf and coastal-sea areas where the SSNs are at a disadvantage, the Royal Navy has 13 'Oberon' and two 'Porpoise' class conventional diesel-powered boats. These are to be replaced from the late 1980s onwards by 10-12 'Upholder' class vessels based on the Vickers Type 2400 design. These boats will combine the shape, internal arrangement and sensor capability of the SSN with a new quieter conventional submarine propulsion plant and battery. Apart from their normal operational roles, both the conventional submarine types provide a method of inserting covert SAS units into enemy territory without being detected, as they demonstrated during the Falklands war when they landed numerous reconnaissance teams all round the Falkland Islands.

The conventional boats and to a certain extent the SSNs are also tasked with the Royal Navy's offensive minelaying operations during wartime. Unfortunately the mines they carry for this, the Mk 5 ground and the Mk 6 buoyant, are of World War II vintage and have long since become obsolete. However, families of new modular ground mines are available in the UK but the Ministry of Defence (MoD) has shown no interest save in saying that new actuator systems will be procured for the old mine stocks. This reliance on obsolete weapons for the submarine service is not new, especially when it is realized that the Mk 8 Model 4 torpedo in use today, and which sank the Argentine cruiser *General Belgrano*, was in fact originally designed in the mid-1920s, some 60 years ago. In terms of training and other equipment, the submarine service is among the world's best and very often proves itself so against other NATO navies in exercises.

In 1966 the Royal Navy was told that its fixed-wing aircraft strength was to be scrapped. Over a period (and using various subterfuges to get around political and Treasury objections) the three-ship 'Invincible' class of light aircraft-carrier was evolved to carry the BAe Sea Harrier V/STOL fighter-bomber. Carrying an air group of six V/STOL jets and 9-12 Westland Sea King anti-submarine and AEW (airborne early-warning) helicopters, these ships are designed for the ASW role. They also carry limited stocks of nuclear depth bombs and tactical free-fall gravity bombs in their magazines. To complement these they also have a wide range of conventional ASW, air-to-surface and air-to-air stores for a conventional conflict. However, in a carrier-to-carrier engagement such as that with a Soviet 'Kiev' class VTOL or 'Kremlin' class conventional fixed-wing carrier, the small number of Sea Harriers carried would not be enough. The only carrier that the Royal Navy has available to embark a significant number of aircraft, HMS *Hermes*, is considered manpower-intensive and is now languishing alongside at Portsmouth as a training vessel before going to scrap when HMS *Ark Royal*, the third 'Invincible', commissions.

The two LPDs (amphibious transport docks), HMS *Fearless* and HMS *Intrepid*, form the major component of the amphibious warfare forces, and were the prime instruments of British ability to retake the Falklands; without their specialized equipment an amphibious landing would have been impossible. There is, however, a need in the next year or so to order replacements if the continued policy of being able to project the Royal Marines on amphibious operations throughout the world is to be maintained. Although the MoD is apparently looking at the situation as part of a study, it is probable that any positive attitude displayed will only result in an order placed too late to provide any continuity.

The other major surface ships are the large destroyers HMS *Bristol*, HMS *Fife* and HMS *Glamorgan*, which were to have been deleted prematurely under the 1982 Defence Review findings. But because of the Falklands reappraisal and the fact that all three units offer extensive flagship facilities not found in any other surface ships save the carriers and LPDs, all three will serve on into the early 1990s. The *Bristol* is especially useful to the Navy as she is one of the few RN flagships that has the necessary data links to communicate directly with US Navy and French navy action information systems. It is possible that the vessels will eventually be superseded by the Type 22 Batch 3 frigates or a Sea Dart-armed derivative of this type.

HMS Bristol _was to have been the first of a class designed to escort the abortive CVA-01 fleet carrier project, but no other 'Type 82' was built. The vessel has found a use as a flagship, her large size allowing comprehensive command and control facilities._